SPACE STATION

SCIENCE AND APPLICATIONS

UTILIZATION PLAN

FOR

U.S. USERS

August 1988

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SCIENCE AND APPLICATIONS
UTILIZATION PLAN
FOR
U.S. USERS

PREPARED BY THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S OFFICE OF SPACE SCIENCE AND APPLICATIONS

IN COORDINATION WITH THE:

NATIONAL BUREAU OF STANDARDS
NATIONAL INSTITUTES OF HEALTH
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL SCIENCE FOUNDATION
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
U.S. DEPARTMENT OF AGRICULTURE
U.S. DEPARTMENT OF ENERGY
U.S. GEOLOGICAL SURVEY

August 1988

FOREWORD

The Space Station Science Operations Management Concepts (SSSOMC) study identified alternative approaches for the management of Space Station science operations. The study, completed in August 1987, was performed jointly by the National Aeronautics and Space Administration's (NASA's) Office of Space Science and Applications (OSSA) and Office of Space Station (OSS). Participation also included other NASA Headquarters offices and field centers, other federal agencies, members of the private sector, and a significant number of scientists from academia. Representatives of the other three Space Station International Partners (i.e., ESA, Japan, and Canada) were included as observers.

A principal recommendation of the SSSOMC study report was that OSSA develop a comprehensive Space Station Science and Applications Utilization Plan (SSSAUP) which establishes a management architecture and framework for the utilization of the Space Station. This document is submitted in response to the SSSOMC recommendation.

The SSSAUP, which follows, was developed under the oversight of the Space Station Science Users' Management Committee (SSSUMC) with membership from NASA Headquarters offices and field centers, the National Bureau of Standards (NBS), the National Institutes of Health (NIH), the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF), the National Telecommunications and Information Administration (NTIA), the United States Department of Agriculture (USDA), the United States Department of Energy (DOE), and the United States Geological Survey (USGS). Two salient features of the SSSAUP are:

(1) The plan is not limited to OSSA's utilization of the Space Station but rather assumes a national perspective and establishes a framework for the utilization of the Space Station by all federally sponsored U.S. science and applications users.

(2) The plan establishes a management framework which facilitates the direct involvement of the science and applications community in the earliest, and all subsequent, planning phases of the science operations process.

The plan is intended to remain in effect indefinitely and will be under the control of the OSSA Level I Space Station Board.

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EXECUTIVE SUMMARY

INTRODUCTION

The Space Station Science and Applications Utilization Plan (SSSAUP) defines the management architecture which will be employed to facilitate utilization of the Space Station by federally sponsored science and applications users.

THE SPACE STATION

The Space Station will support the conduct of scientific research, the development of technology, and the advancement of commercial enterprise. The Space Station Program will be international in scope and will involve the United States, Canada, Japan, and the consortium of nations which comprise the European Space Agency (ESA). The "Station" will provide both manned and unmanned elements. The manned facility will be placed in a low earth orbit of about 500 kilometers at an inclination to the equator of 28.5 degrees and will consist of a central horizontal truss to which 4 pressurized modules will be attached. Three of the modules will be outfitted to serve as laboratories and the fourth as living quarters for Space Station crews. Provisions for external payloads attached to the horizontal truss will be provided. A robotic manipulator system will be available to support assembly and other activities external to the modules. In addition, a Man-Tended Free-Flyer (MTFF) (a self-contained, self-supporting pressurized laboratory) will co-orbit and operate in conjunction with the manned facility. The Station's unmanned element will be two free-flying platforms in high-inclination or polar orbit. These platforms will provide changeable payload accommodations for activities requiring minimum disturbance and protection from contamination.

Allocation of Space Station resources among users will be done on an international basis in compliance with the Memoranda of Understanding (MOU's) among participating nations. These agreements entail the following top-level allocation of resources: United States, 71.4%; Canada, 3.0%; Japan, 12.8%; and ESA, 12.8%. Each International Partner will be responsible for its own internal allocation of resources among users. U.S. resources must be shared by science, technology, and commercial users.

THE U.S. SCIENCE COMMUNITY AND SPACE STATION

Within the U.S. space science and applications communities, different discipline areas are supported by different U.S. Government agencies. By far, the most dominant source of funds and resource opportunities for most of these disciplines is the NASA Office of Space Science and Applications (OSSA). Other space science and applications research programs, generally in more limited discipline areas, are supported by the the National Bureau of Standards (NBS), the National Institutes of Health (NIH), the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF), the National Telecommunications and Information Administration (NTIA), the U.S. Department of Agriculture (USDA), the U.S. Department of Energy (DOE), and the U.S. Geological Survey (USGS). Collectively, these science agencies intend to use the Space Station to conduct research in the disciplines of Life Sciences, Materials Sciences, Astrophysics, Earth Sciences, Space Physics, Solar System Research, and Communications.

<u>In recognition of their many common interests and probable oversubscription of Space Station resources, the U.S. science agencies have agreed to coordinate their utilization of the Space Station. It has been further agreed that OSSA will assume the leadership responsibility for such coordination and, in collaboration with the other agencies, will function as the integrator for all U.S. science utilization activities.</u>

SPACE STATION SCIENCE OPERATIONS

In order to develop a management framework for science utilization, the entire end-to-end Space Station science operations process must be well understood. Figure A presents a simplified characterization of this process which was developed by coupling the Space Station operations control process, recently developed by the Space Station Operations Task Force (SSOTF), with the traditional life-cycle activities of a space science program.

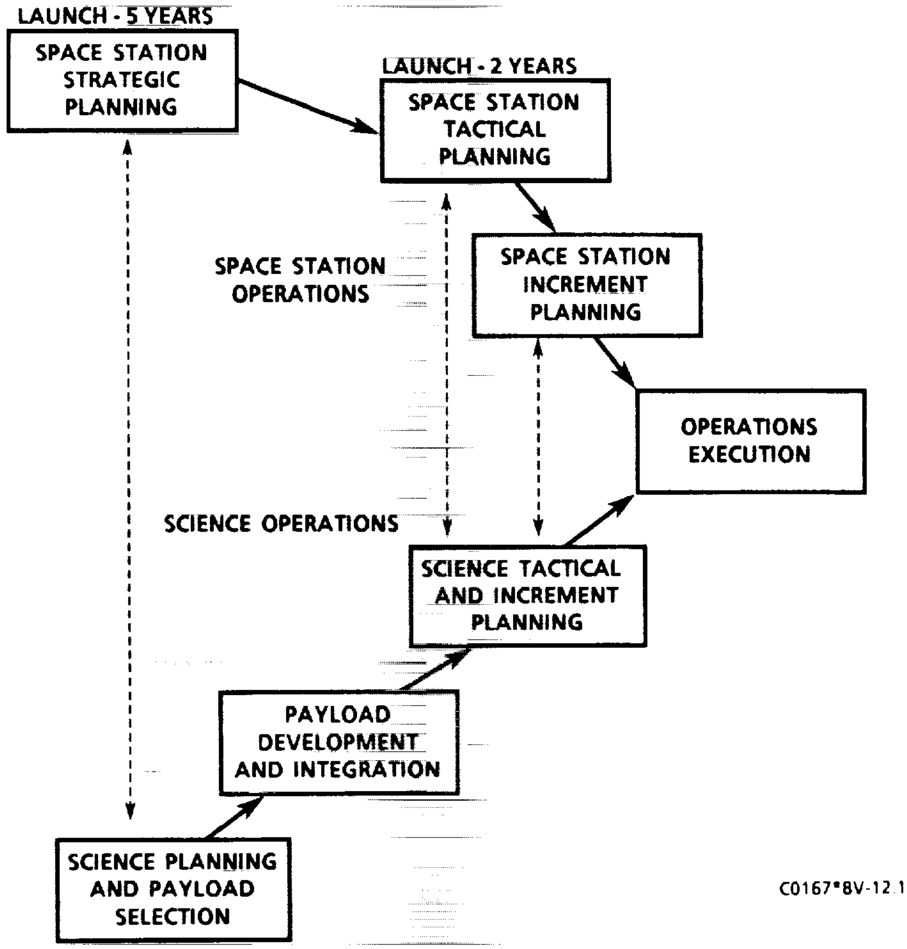

Figure A. Space Station Science Operations

The Space Station operations control process consists of the following elements:

(1) Strategic Planning: Develops a 5-year resource allocation plan.

(2) Tactical Planning: Converts the strategic plan into a detailed second-level integration plan for the upcoming 2 years.

(3) Increment Planning: Develops detailed flight and ground procedures.

(4) Operations Execution: Provides real-time planning and operations support.

The overall set of activities, of which the traditional science operations process is comprised, can be segregated into the following four phases:

(1) Science planning and payload selection,

(2) Payload development and integration,

(3) Science tactical and increment planning (traditionally referred to as mission planning), and

(4) Operations and data management.

The traditional science operations process can be readily linked with the Space Station operations control process as was done in Figure A. The initial linkage between the two processes takes place between the science planning and payload selection phase of science operations and Station strategic planning. This initial linkage takes the form of a coarse allocation of Station resources for the science program being planned and approved. As individual science projects enter the payload development phase, the linkage becomes stronger with refined resource envelopes and ultimately with precise interface agreements being defined with the Station. In the respective tactical and increment planning phases of the two processes, many of the activities (such as the development of an overall increment timeline) will become very tightly interwoven. Ultimately, the two respective operational phases of the two processes blend together into a single, unified Space Station science operations process with shared responsibilities.

SCIENCE MANAGEMENT ARCHITECTURE

This section identifies and establishes the top-level management framework for the utilization of the Space Station by the U.S. science and applications community. <u>The management framework assigns responsibility for coordinating and focusing all U.S. science and applications uses of the Space Station to NASA/OSSA and, at the same time, accommodates substantial participation by other Government agencies.</u>

The utilization of the Space Station will be governed by policies established at the highest levels of the Federal Government. It can be expected that these policies will be imposed on users in a top-down process. However, the planning and execution of science and applications utilization activities, within the "boundary conditions" set by such policies, will be a bottom-up process in which goals and plans germinate directly from within the science community.

Interagency Coordination

Figure B presents a simplified characterization of the process for coordinating agency programs and plans. In this process, multiagency Discipline Working Groups (DWG's) will propose science goals and priorities, and agency discipline offices will consider these proposals, modify them as required, and extrapolate the resulting goals and priorities into specific plans and programs. The various agency offices active in a given discipline will then work together to develop a nationally coordinated discipline utilization plan. OSSA will then assume responsibility for formulating a proposed multiagency and multidisciplinary plan for the coordinated utilization of the Space Station by all U.S. science and applications users. This plan will be submitted to the Space Station Science and Applications User Board (SSSAUB) for approval and formal submittal into the overall Space Station strategic planning process.

Membership of the SSSAUB will consist of a single senior official from each of the participating Federal agencies. OSSA will provide the SSSAUB chairman and will provide technical and administrative support, as required.

International Coordination

Science coordination with the International Partners and/or other nations will be accomplished by traditional, less formal mechanisms. The Partners will be invited to provide representatives to the various DWG's, and individual agencies will be encouraged to collaborate with international science organizations in the development and use of scientific instrumentation and in the sharing of data.

Agency Management Structures

OSSA has an established space science management infrastructure which has successfully supported the traditional end-to-end science operations process for numerous programs for many years. This infrastructure represents a major national resource and a major national investment. It is the objective of this plan that the OSSA infrastructure not be needlessly duplicated and that it be made available to all U.S. agencies as appropriate. For access to, and use of, the OSSA management infrastructure

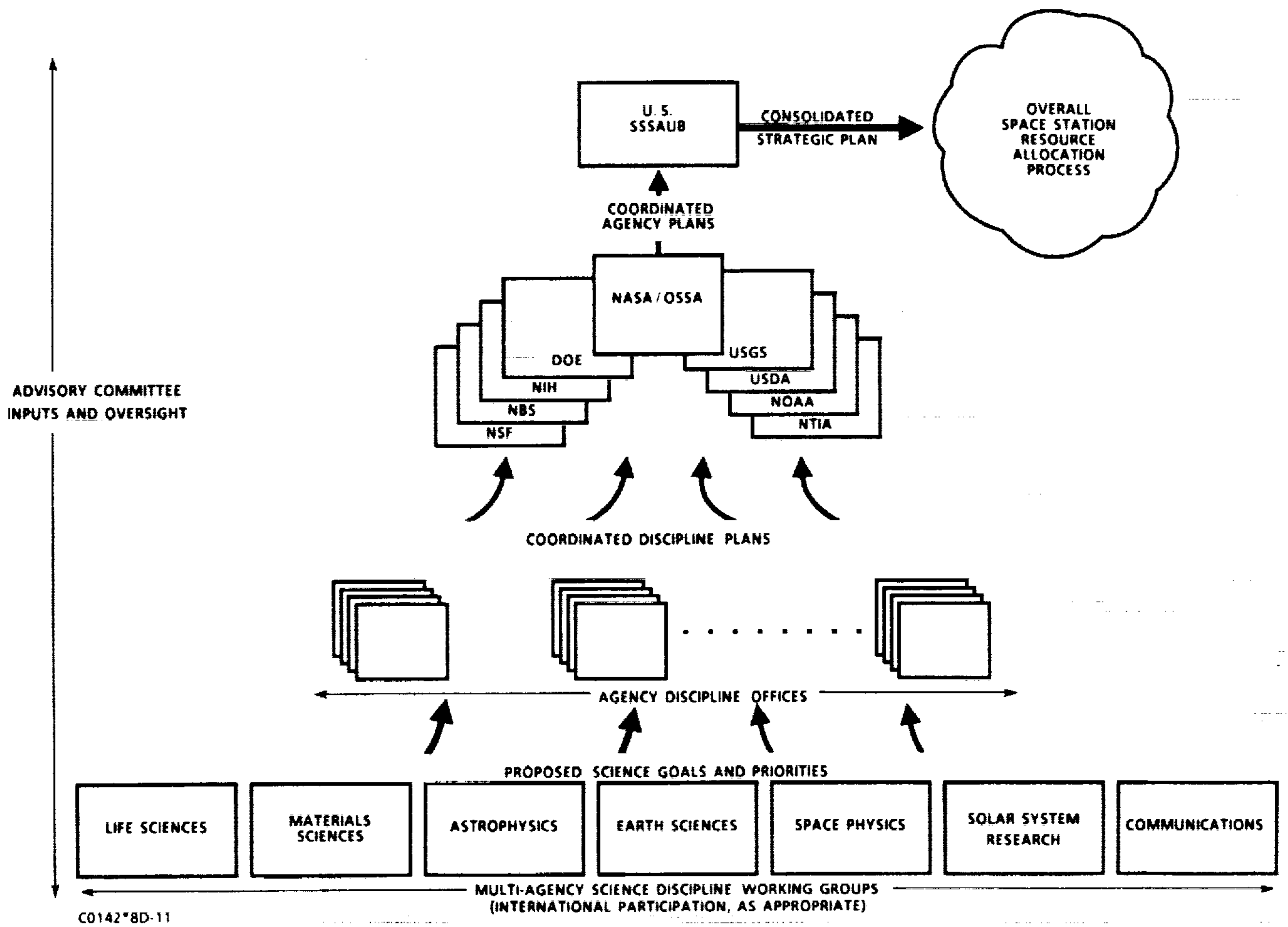

Figure B. Bottom-Up Formulation of Space Station Science Strategic Plans

and its associated facilities and systems, quid pro quo arrangements will be developed between OSSA and the other agencies.

Figure C displays the functional and management arrangements which OSSA will apply to Space Station utilization. The OSSA Associate Administrator (AA), who reports directly to the NASA Administrator, will oversee OSSA's Space Station activities and will ensure that these activities are properly balanced with the overall OSSA science program.

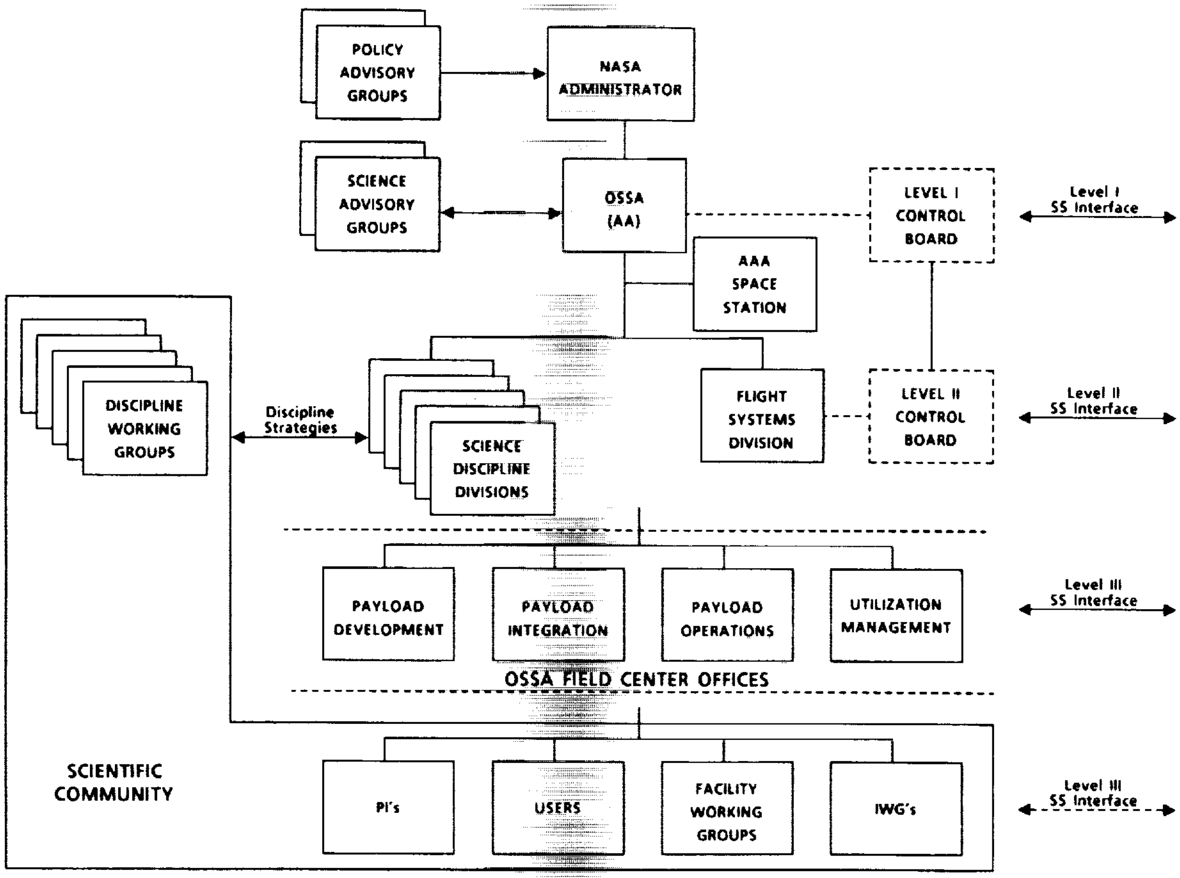

Figure C. OSSA Space Station Management Support Structure

The formulation of specific science plans and strategies will be the responsibility of the OSSA science discipline Divisions: Astrophysics, Communications and Information Systems, Earth Science and Applications, Life Sciences, Microgravity Science and Applications, Solar System Exploration, and Space Physics. The Division plans and strategies will, to the extent appropriate, reflect the goals, objectives, and priorities proposed by DWG's. Management and systems integration across disciplines will be the responsibility of the Flight Systems Division.

Responsibility for the major implementation functions of development, integration, operations, and multidiscipline utilization management will be distributed among the various OSSA support offices within the NASA field centers. A number of distribution arrangements will be used to service discipline needs.

Participation of the science community will take several forms. Principal Investigators (PI's) will be competitively selected to develop and operate unique scientific instrumentation. Facility working groups will guide the definition, development, and operation of multipurpose science facilities, and science users of these facilities will be competitively selected. PI's and science users will be organized into Investigators Working Groups (IWG's) to provide coordinated planning and execution of flight operations.

The other science agencies will have similar distributions of management functions within their organizations and will interface with the various OSSA organizations as required.

MANAGEMENT OF THE SPACE STATION SCIENCE OPERATIONS PROCESS

The general evolution of management focus, as a project moves through the different phases of the entire science operations process, will be similiar for most Space Station science projects. Initially, management focus will reside at the Headquarters level during the science planning and payload selection phase and then typically transition to a field center focus during the subsequent stages of the process. The science community will have an active and influential voice throughout the entire process, initially via the DWG's, then through PI's, and finally by IWG's once payload complements are established.

A fundamental strategy to be employed for the management of the Space Station science operations process will be to develop compatible groupings of science instrumentation which can be spatially and temporally clustered on the Space Station within the resource envelope allocated to U.S. science. Such an approach will facilitate effective science operations and allow the application of traditional management approaches which have proven successful for many years.

CHAPTER 1
INTRODUCTION

The Space Station Science and Applications Utilization Plan (SSSAUP) defines the management architecture which will be employed to facilitate utilization of the Space Station by science and applications[1] users sponsored by the Federal Government of the United States (U.S.). The plan does not attempt to present detailed Space Station utilization procedures.

Chapter 2 of the plan starts with a description of the Space Station and the research opportunities that it offers to the U.S. science community. The current schedule for Station development is presented, and the process for allocating resources among Station users is discussed.

In Chapter 3, the various U.S. Space Station science user communities are identified, and their highest priority uses of the Station are discussed. Principles of cooperation among the U.S. science agencies which will sponsor scientific research on the Space Station are also presented.

In Chapter 4, the end-to-end Space Station science operations process is described. First, an overview of the recently proposed Space Station operations control process is presented. Next, a characterization and description of the traditional science operations process is provided. The chapter concludes with a coupling of these two processes into a unified Space Station science operations process.

Chapter 5 presents the top-level management framework that will be used to facilitate the utilization of the Space Station by the U.S. science community. Management mechanisms for the coordination of activities among and between the various U.S. science agencies are presented. Next, internal agency management structures are discussed, and the chapter concludes with a discussion of the role of the science community.

In Chapter 6, the plan concludes with a description of how the management framework, presented in Chapter 5, will most typically be applied to the end-to-end Space Station science operations process.

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[1]For purposes of simplicity, this report frequently uses the word "science" to encompass both "science" and "applications."

CHAPTER 2
THE SPACE STATION OPPORTUNITY

2.1 SPACE STATION OVERVIEW

2.1.1 Baseline Program

The Space Station is the next major development in the United States' civil space program. Not since the highly successful Skylab program of the early 1970's has the U.S. maintained a long-term manned presence in Space. The Space Station, with its accommodations for up to eight crew and its extensive pressurized laboratory facilities, will provide such a presence and will support the diversity of scientific, engineering, and commercial endeavors which require both a permanent presence in space and manned intervention and support to achieve their objectives.

The Space Station design is both versatile and evolutionary in nature. As currently conceived, the initial Space Station will provide both manned and unmanned elements. The Station Manned Base will be assembled in a low-altitude (~400 km), low-inclination (~28.5 degree) earth orbit using the Space Shuttle. It will consist of a 120-meter central horizontal truss to which 4 pressurized modules will be attached. Three of the modules will be outfitted as laboratories, while the fourth will contain the living quarters for the eight-person Station crew. The Station will be powered initially by four large photovoltaic solar arrays which are attached to the central truss, as shown in Figure 1. Also situated on the truss will be four external payload accommodation sites. Station-supplied interface equipment designed to support a range of user-supplied earth-looking and sky-looking external payloads will be provided. In addition, a robotic manipulator system will be available to support Station and payload assembly and other activities external to the modules.

The unmanned element of the early Space Station will be two free-flying platforms in high-inclination or polar orbits. These platforms will provide accommodations for a number of different earth-viewing instruments

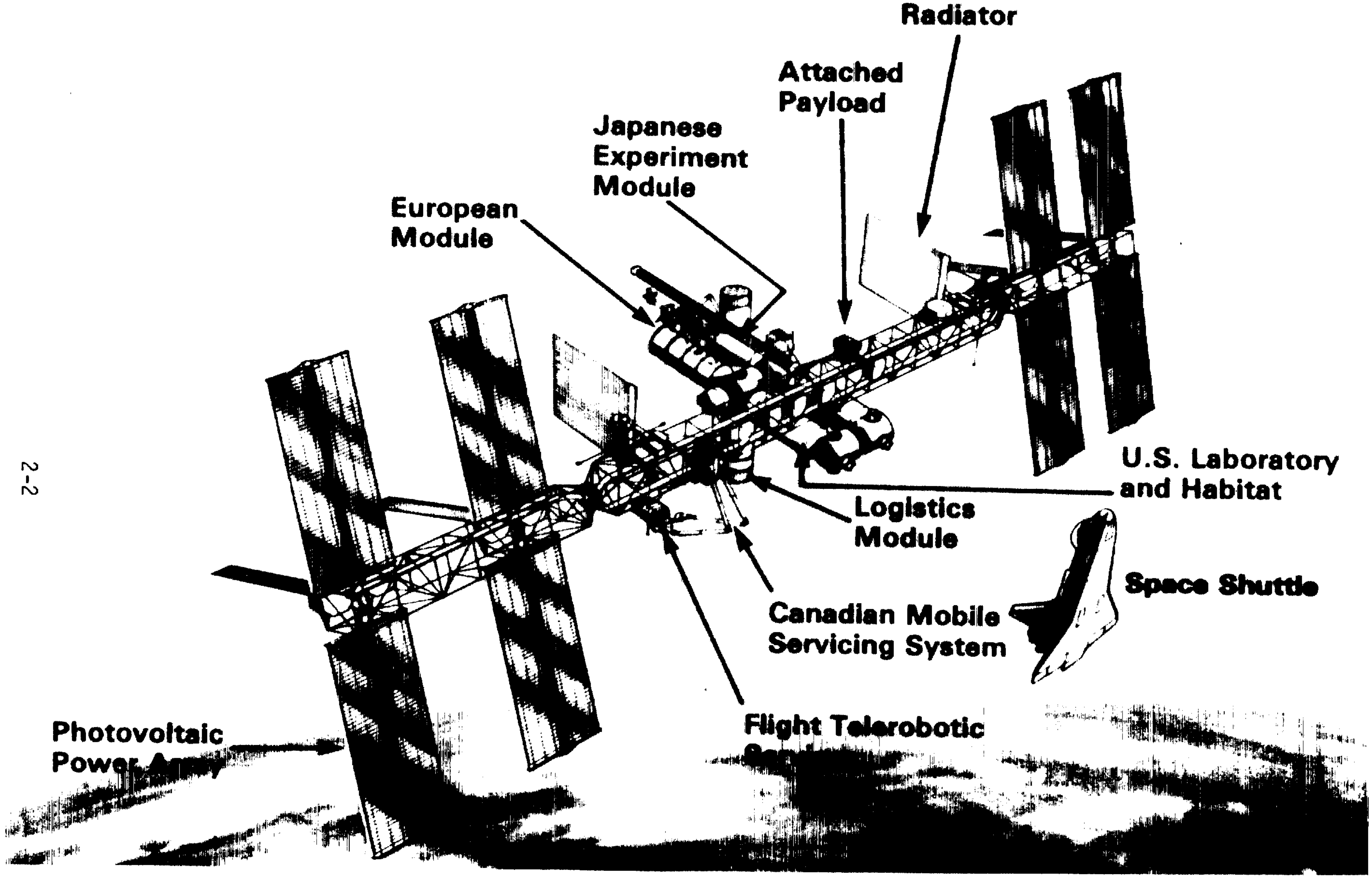

Figure 1. Space Station Configuration

requiring minimum disturbance, protection against contamination, and an earth-surface coverage only attainable from a high-inclination orbit.

Access to the Station will be provided by the Space Shuttle. Ongoing studies are evaluating the suitability of using other launch vehicles to augment the capability of the Space Shuttle. The ground-based infrastructure needed to operate the Space Station's Manned Base and unmanned platforms and their respective payloads will also be provided. This infrastructure will include facilities for mission control, launch processing, and training and testing. Communications to and from the Station will primarily be accomplished using the NASA Tracking and Data Relay Satellite System (TDRSS).

2.1.2 Station Evolution

A fundamental facet of the design of the Station will be its ability to continue to evolve beyond the baseline configuration described above. Options for future augmentations to the Station's Manned Base include the addition of upper and lower booms (which will be able to accommodate up to 20 external attached payloads), increased Station resources, and an environmentally protected satellite servicing facility. The advanced Station will also provide accommodations for a Station-based Orbital Maneuvering Vehicle (OMV) which will be used for capture and reboost of the free-flyers which could be serviced at the Station. The Station's unmanned element may be augmented by a co-orbiting platform, which will be serviced at the Manned Base.

2.1.3 International Contributions

An important aspect of the Space Station program is its international nature. The initial Station configuration outlined above includes elements provided by four International Partners: the United States, the European Space Agency (ESA), Japan, and Canada. Thus, the U.S., which is the primary contributor to the Station program, will provide the central horizontal truss; the pressurized habitation module; one of the laboratory modules; docking ports, airlocks, and interconnecting nodes; the

Manned Base power and communications systems; the flight telerobotic servicer; the Space Station Information System (SSIS), which includes use of the TDRSS; one of the polar platforms; and the Shuttle assembly and logistics flights.

The U.S.-provided laboratory module will be designed to accommodate projects that need stable microgravity environments. Such projects include materials research and development and research in basic biology, physics, and chemistry. Crew rest and living quarters will be contained in the habitation module. This module will also contain facilities for health services, recreation, waste disposal, and other essential services required to support the sustained on-orbit presence of the Station crew.

Japan and ESA will each provide one of the two remaining pressurized laboratory modules: the Japanese Experiment Module (JEM) and the "Columbus" laboratory module, respectively. Both of these laboratories will be multipurposed but will be designed primarily for research into the fields of fluid physics, life sciences, and materials processing. In addition, the JEM will include an exposed (unpressurized) area for the attachment of external payloads and a remote manipulator arm with an associated control center. Japan will also provide a logistics module, and ESA will provide the second unmanned polar-orbiting platform. Canada will provide the Mobile Servicing System (MSS) which will be used to support external attached payload servicing, Space Station Manned Base assembly and external maintenance, transportation for deployment and retrieval activities, and crew Extra-Vehicular Activity (EVA). The Station crew will be multinational.

In addition, ESA will provide a Man-Tended Free-Flyer (MTFF) which will be a self-contained, self-supporting pressurized laboratory to co-orbit and operate in conjunction with the Space Station. The MTFF will have two major components: (1) a Free-Flying Pressurized Laboratory Module (identical to the Columbus module) which will carry the payloads, and (2) a Resource Module which will provide utilities. In the man-tended mode, the MTFF will be docked with the Space Station which will provide power, cooling, air for the crew, potable water, and waste transfer. (Depending on the docking configuration, the MTFF could supply resources concurrently.) In the unmanned mode, the MTFF will operate under European Mission Control Center control.

2.2 CURRENT DEVELOPMENT SCHEDULE

Current plans call for an initial Station Manned Base assembly sequence of 19 Shuttle flights to start in early 1995 and culminate with the completed "Phase I" Station in late 1998. Opportunities for man-tended, pressurized module payloads will be available from late 1995 until permanent manning of the Station in 1996. Opportunities for small attached payloads may be available early in the assembly sequence, and larger attached payloads should begin to operate in early 1996. Launches of the U.S. and ESA polar platforms are planned for 1995 and 1997, respectively.

2.3 ALLOCATION OF STATION RESOURCES

2.3.1 International Partners

Each of the four International Partners plans to use the Station for scientific and technology research and, possibly, for commercial ventures. To facilitate such use, the resources available to support users of the Space Station have been divided and allocated to the Partners in accordance with negotiated Memorandum of Understanding (MOU) agreements. Thus, the U.S. has been allocated 71.4% of the available Station resources, ESA and Japan have each been allocated 12.8%, and Canada 3%. Table 1 presents the specific percentage allocations by Station element from which these higher-level percentages were derived. A Multilateral Coordination Board (MCB), including representatives of each of the International Partners, will ensure the equitable allocation of resources among the Station users.

TABLE 1. SPACE STATION INTERNATIONAL UTILIZATION ALLOCATIONS

	U. S.	CANADA	ESA	JAPAN
MANNED BASE				
1. Utilization Resources	71.4%	3.0%	12.8%	12.8%
2. User Accommodations				
a. NASA Lab Module	97%	3%		
b. NASA Attached Payload Accommodations Equipment	97%	3%		
c. ESA Attached Pressurized Module (APM)	46%	3%	51%	
d. ESA Man-Tended Free Flyer (MTFF)	(25%) (Option to use)		100%	
e. Japanese Experiment Module (JEM), consisting of a pressurized module, an exposed facility, and experiment logistics modules	46%	3%		51%
PLATFORMS				
a. NASA Polar Platform	*	3%	*	
b. ESA Polar Platform	*	3%	*	

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* Shared on a balanced reciprocal basis. Users may propose specific splits on actual payloads.

2.3.2 U.S. User Communities

The algorithms whereby the U.S. will divide its allocated resources among its various user communities are still undecided. At this time, five different categories of U.S. users have been identified:

(1) The space science and applications communities;

(2) The space technology research communities;

(3) The commercial users of the Station, who may use the Station for basic commercial research and development (R&D);

(4) The commercial users of the Station who wish to undertake industrial production in orbit; and

(5) Other (e.g., non-partner international users applying through the U.S. allocation).

Of these five, it is anticipated that space science and applications will be the dominant Station user in the early years of the program. The space technology research program (which involves experiments in space structures, space environmental effects, energy systems and thermal management, automation and robotics, information systems, in-space operations, and human performance) is expected to grow over time. NASA is, additionally, attempting to develop an informed commercial user community by encouraging commercial R&D activities leading to commercial use of the Space Station, supporting commercial outreach and marketing activities, identifying and developing operational policies and procedures which will accommodate commercial users, and promoting an industrial network to assist NASA in planning for the commercial use of the Station. For example, the NASA Microgravity Strategic Plan (currently being developed by the Office of Commercial Programs) will include provisions for close cooperation between NASA and privately sponsored microgravity researchers.

A management framework for allocating U.S. user resources has been defined by the Space Station Operations Task Force (SSOTF) and is discussed in Section 4.2 of this document. According to the SSOTF, the primary body responsible for this allocation of resources will be the (U.S.) Space Station User Board (SSUB) which will have representation from each of the major U.S. Station users.

Actual allocations of Station resources will be made by the NASA Administrator to the five primary user categories and will depend on: national policies and priorities, advisory board recommendations (e.g., the recommendations of the Microgravity Research Board), the availability of resources (Station and funds), and the overall integration of user requirements (i.e., demand for specific Station resources).

CHAPTER 3
THE U.S. SCIENCE COMMUNITY AND SPACE STATION

3.1 SCIENCE ORGANIZATIONS OVERVIEW

The U.S. space science and applications communities have been established largely as a result of the research and funding opportunities presented by NASA. For historical reasons, these communities may be divided into seven major discipline areas: Life Sciences, Materials Sciences, Astrophysics, Earth Sciences, Space Physics, Solar System Research, and Communications.

Each of these seven areas contains a number of subdisciplines. Thus, Life Sciences includes space medicine, operational medicine, biological research, and exobiology. Materials Sciences includes research into electronic materials, metals and alloys, glasses and ceramics, biotechnology, combustion, and fluid dynamics and transport phenomena and is associated with fundamental research in physics and chemistry. Astrophysics includes gamma-ray and X-ray "high-energy" astrophysics; ultraviolet and visible light astronomy; infra-red, submillimeter, and radio astronomy; and relativity. Earth Sciences includes atmospheric physics, upper-atmosphere research, weather and climate research, ocean and land processes, and geodynamics research. Space Physics includes solar and heliospheric research, cosmic ray research, and plasma physics. Solar System Research includes planetary science, planetary atmospheres, and geoscience. Finally, Communications includes basic research into communications technologies.

Within the U.S. space science and applications communities, different discipline areas are supported by different U.S. government agencies. By far, the most dominant source of funds and research opportunities for most of these disciplines is the NASA Office of Space Science and Applications (OSSA). Other space science and applications research programs, generally in more limited scientific and applications discipline areas, are supported by the National Bureau of Standards (NBS), the National Institutes of Health (NIH), the National Oceanic and

Atmospheric Administration (NOAA), the National Science Foundation (NSF), the National Telecommunications and Information Administration (NTIA), the U.S. Department of Agriculture (USDA), the U.S. Department of Energy (DOE), and the U.S. Geological Survey (USGS). Some of these Government agencies participating in the U.S. Space Station science program have long histories of sponsoring space science and applications research, generally in cooperation with NASA. Other agencies, recognizing the significant scientific potential of the Space Station, are only now planning to enter the space arena. However, few of these agencies are in a position to develop the infrastructure needed to make use of this opportunity and prefer to collaborate with NASA in their early use of the Station.

Typically, the range of disciplines sponsored by each of these other U.S. Government agencies is less ambitious than that sponsored by NASA and is closely related to their respective areas of responsibility. The primary scientific interests of each of these organizations at this time are provided in Figure 2. A distinction is made between a major area of planned Space Station utilization and a secondary area of planned utilization. A major area of utilization would involve an activity in which the agency in question intends to assume a lead role in defining and implementing flight programs. Secondary utilization would involve a supportive role (e.g., data analysis only) or a modest level of activity for the agency in question.

It is possible that, as the Station's capabilities to support research become better known, more agencies will participate, and the range of programs sponsored by each of the participating agencies may expand. The envelope of science opportunities, captured within the science disciplines listed in Figure 2, is immense and extremely diverse. It is intended that this Space Station Science and Applications Utilization Plan (SSSAUP) will establish the management framework needed to support and facilitate this envelope of science activities.

In the following section, a brief overview of each of the seven major science disciplines is provided. Top-level goals are listed along with a discussion of how Space Station utilization can contribute to the realization of these goals. While these discussions are oriented toward

	NASA	NBS	NIH	NOAA	NSF	NTIA	USDA	USGS	DOE
LIFE SCIENCES	X		X		O		X		
MATERIALS SCIENCES	X	O	O		O		O		O
ASTROPHYSICS	X	O			O				
EARTH SCIENCES	X			X	O		X	X	X
SPACE PHYSICS	X			X	O				
SOLAR SYSTEM RESEARCH	O				O				
COMMUNICATIONS	O			O	O	O			
OTHER		O		O	O				

NOTE: This matrix is merely intended to be representative of the range of agency interests in utilizing the Space Station.

X - Major Area of Planned SS Utilization
O - Secondary Area of Planned SS Utilization

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Figure 2. U.S. Science Agencies and Discipline Plans

OSSA plans for Space Station utilization, many aspects of the utilization plans of the other science agencies are also captured. Appendix A provides more detailed information on the discipline goals and Space Station plans of the other science agencies.

3.2 THE SCIENCE DISCIPLINES

A summary of the ways in which all of the major science and applications users of the Station plan to use its new research opportunities is provided in Figure 3. The following subsections provide additional details concerning each of the discipline goals for conducting research at the Space Station.

3.2.1 Life Sciences Research

The goals of Life Sciences Research on the Space Station are to advance knowledge of the fundamental behavior of living cells, guarantee the health and safety of astronauts living and working in space, and understand the evolution of life in the universe.

OSSA DISCIPLINE	STATION ATTACHED PAYLOAD	STATION PRESSURIZED MODULE	STATION PLATFORMS	STATION-BASED SERVICING
ASTROPHYSICS				
COMMUNICATIONS			COP	
EARTH SCIENCES			EOS ON NPOP & EPOP	
LIFE SCIENCES			BIOSPHERICS *	
MATERIALS SCIENCES				
SPACE PHYSICS			NPOP & EPOP IN SUPPORT OF EOS	
SOLAR SYSTEM RESEARCH	WITH LIFE SCIENCES	WITH LIFE SCIENCES		

* LIFE SCIENCES RESEARCH IN BIOSPHERICS WILL BE CONDUCTED USING SHARED DATA FROM THE EOS PLATFORM

USAGE KEY: HIGH LOW NONE

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Figure 3. Space Station Science Utilization by Discipline

The program is divided into five basic elements: Space Biology, which includes gravitational, radiation, and developmental biology; Space Medicine, which includes sensorimotor integration, bone and mineral metabolism, cardiovascular and pulmonary functions, and muscle atrophy, anemia, nutrition, and behavior studies; Closed Ecological Life Support System (CELSS); Biospherics; and Exobiology, which includes research into the cosmic evolution of life.

Life Sciences research will primarily rely on the use of a complement of "facility-class" equipment that will be housed in the Station's pressurized laboratories. During Phase I of the Station program, the planned 1.8-meter variable-gravity centrifuge facility and the gas-grain simulator facility are among the required elements of the life science program. Also under consideration is an external attached payload, the cosmic dust collector, which will be developed jointly with the Solar System Research program. Additional facilities (which include a large-diameter, variable-gravity centrifuge facility, a complete human research module, an animal and plant vivariam module, and a CELSS module) are planned for the Phase II Station.

3.2.2 Materials Sciences Research

The goal of Materials Sciences Research on the Station is to use the microgravity environment of space to advance knowledge of fundamental science and to apply the knowledge gained to the development of advanced processes and technologies.

Elements of the program include electronic materials research, biotechnology, combustion science, fluid dynamics and mass transport, metals and alloys, glasses and ceramics, and fundamental research in physics and chemistry. Research into all of these elements will be conducted using a variety of different facility-class equipment which will be housed in the Station's pressurized laboratories. Particular attention will be paid to the microgravity environment to which the laboratories are subjected. Materials Sciences facilities currently planned for development for the early Station will include a furnace facility, a modular combustion facility, a fluid physics and dynamics facility, a modular containerless processing facility, an advanced protein crystal growth facility, and a biotechnology facility.

3.2.3 Astrophysics

The Astrophysics community intends to capitalize on the unique attributes of the Space Station Manned Base and its co-orbiting platform to enhance astronomical research. These attributes include capability to support long (multiyear to multidecade) observation times through replenishment of consumables, upgrade of payloads and repair or replacement of failed or degraded systems, assembly of large experiments in space, and rapid-response research. Overall science goals of the Astrophysics program are to understand the origin and evolution of the universe, the laws of physics that govern it, and the nature of galaxies, stars, planets, and life.

Initially, the Astrophysics program will use the Station's attached payload capability to support modest instruments. More ambitious instruments will be supported once the Station's capabilities are better understood.

The primary candidate for the Station co-orbiting platform, which may be developed during Phase II of the program, is the Astrophysics program's Space Infrared Telescope Facility (SIRTF). This free-flying infrared telescope is an element of the Great Observatories program. Two other elements of the program, the Hubble Space Telescope (HST) and the Advanced X-Ray Astrophysics Facility (AXAF), are planned to be operational during both Phase I and Phase II of the Station program. All of these Great Observatories will depend on on-orbit servicing from either the Space Shuttle or the Station Manned Base to achieve scientifically productive extended operational lifetimes.

3.2.4 Earth Sciences

The goal of earth sciences research on the Station is to investigate the earth as a system, from its interior through the magnetospheric boundary. The Earth Sciences program on the Station will consist of four basic elements: Geodynamics, which includes research into crustal dynamics and gravitational and magnetic fields; Land Processes, which includes research into terrestrial ecosystems, hydrology, geology, and remote sensing; Oceanography, which includes ocean topography and ice formations; and Atmospheric Dynamics and Radiation, which includes global climate studies, meteorology, and aerology.

The Earth Sciences "Earth Observing System" (EOS) will be the principal user of the polar platform. It will provide long-term observations needed to understand the natural earth system and will contribute to the development of prediction capabilities for natural and manmade changes. The instrumentation for the platform will be both operational and scientific and will be provided primarily by NASA, NOAA, ESA, and Japan.

The Earth Sciences community will use the Station Manned Base to fly external attached payloads which are forerunners of EOS instruments or are complementary to the EOS program.

3.2.5 Space Physics

The goal of Space Physics research on the Space Station is to study the processes that govern the behavior of space plasma in the magnetosphere of the earth and other planets, in interplanetary space, and at the sun. In addition, the Space Station environment will be used as a laboratory for furthering fundamental knowledge of plasma physics.

All three elements of the Space Physics program (i.e., the Solar Physics program, the Space Plasma Physics program, and the Cosmic and Heliospheric Physics program) will benefit greatly from the use of the Station's Manned Base and unmanned platforms.

A number of Space Physics instruments will require the Station's assembly and servicing capabilities for assembly on the Station, for servicing of support systems and expendable resources in order to achieve extended operational lifetimes, and eventually for instrument replacement. In addition, the active plasma physics instruments (and, at times, the solar instruments) will need crew interaction or the direct interaction of ground-based investigators using the Station's telescience capability.

3.2.6 Solar System Research

While not expected to be a major user of the Space Station, the Solar System Research community does plan to use the Station's Manned Base for research that capitalizes on the unique attributes of this opportunity.

Research topics planned for the early Station by the Solar System Research program include a search for other planetary systems and the capture and analysis of cosmic dust. The instruments to be used for these research activities are the Astrometric Telescope Facility and the Cosmic Dust Collection Facility. Both facilities will be developed by NASA with the help and advice of the user community and will be made available to the users through guest-investigator programs. As noted above, the Cosmic Dust Collection Facility will be shared with the Life Sciences program.

3.2.7 Communications

Limited use of the Space Station Manned Base is planned to foster technological advances in Communications systems. Two external attached payload candidates for the early Station are the Laser Communications Engineering Test and the Search and Rescue Interferometer. Search and rescue instrumentation may also be flown on the polar orbiting platforms.

3.3 PRINCIPLES OF COOPERATION

The scientific utilization of the Space Station represents an enormous opportunity to pursue a broad range of science goals and objectives. It is imperative that the scientific utilization of the Space Station be planned and implemented in a judicious manner. In recognition of this fact, those agencies of the U.S. Government intending to use the Space Station for scientific purposes have established the following principles of cooperation.

(1) Each agency will develop its own science goals and Space Station plans.

(2) Agencies will work together to exchange scientific program information and endeavor to:

   (a) Avoid and eliminate unnecessarily redundant science activities, and

   (b) Integrate complementary science programs and plans.

(3) Agencies will coordinate strategic planning and produce an integrated Space Station science and applications strategic plan.

(4) Agencies will promote and support active scientific dialogues with the other international science users of the Space Station and encourage strategies which maximize overall science utilization.

(5) OSSA will focus and coordinate all U.S. science uses of the Space Station.

(6) OSSA will develop and sustain a science support infrastructure (e.g., facilities, equipment, procedures, managerial processes, etc.) which facilitates the scientific utilization of the Space Station. This infrastructure will be made available to other agencies, with quid pro quos being developed on a case-by-case basis.

CHAPTER 4
SPACE STATION SCIENCE OPERATIONS

4.1 INTRODUCTION

In order to develop a management framework for the scientific utilization of the Space Station, it is appropriate to first reach an understanding of the scope of the endeavor that is to be managed. The Space Station science operations process consists of the entire set of end-to-end activities associated with conducting scientific experimentation on the Space Station. This chapter attempts to describe, in a fairly definitive manner, the nature of this process.

First, the operations control process which has been proposed for general Space Station operations is summarized. Next, the traditional science operations process, which has evolved over many years of successful unmanned and manned space science programs, is discussed. Finally, this traditional science operations process is coupled to the Space Station operations control process, and an integrated characterization of the Space Station science operations process is presented.

4.2 SPACE STATION OPERATIONS CONTROL PROCESS

The Space Station Operations Task Force, established at the direction of the NASA Associate Administrator for the Office of Space Station, has developed a planned operations control process to which all users of the Space Station must adhere. The operations control process will be led by NASA but will be international in scope with full participation by each of the International Partners. The process will consist of four stages: strategic planning, integrated tactical planning, increment planning, and operations execution. Figure 4 presents a simplified flow diagram of the process.

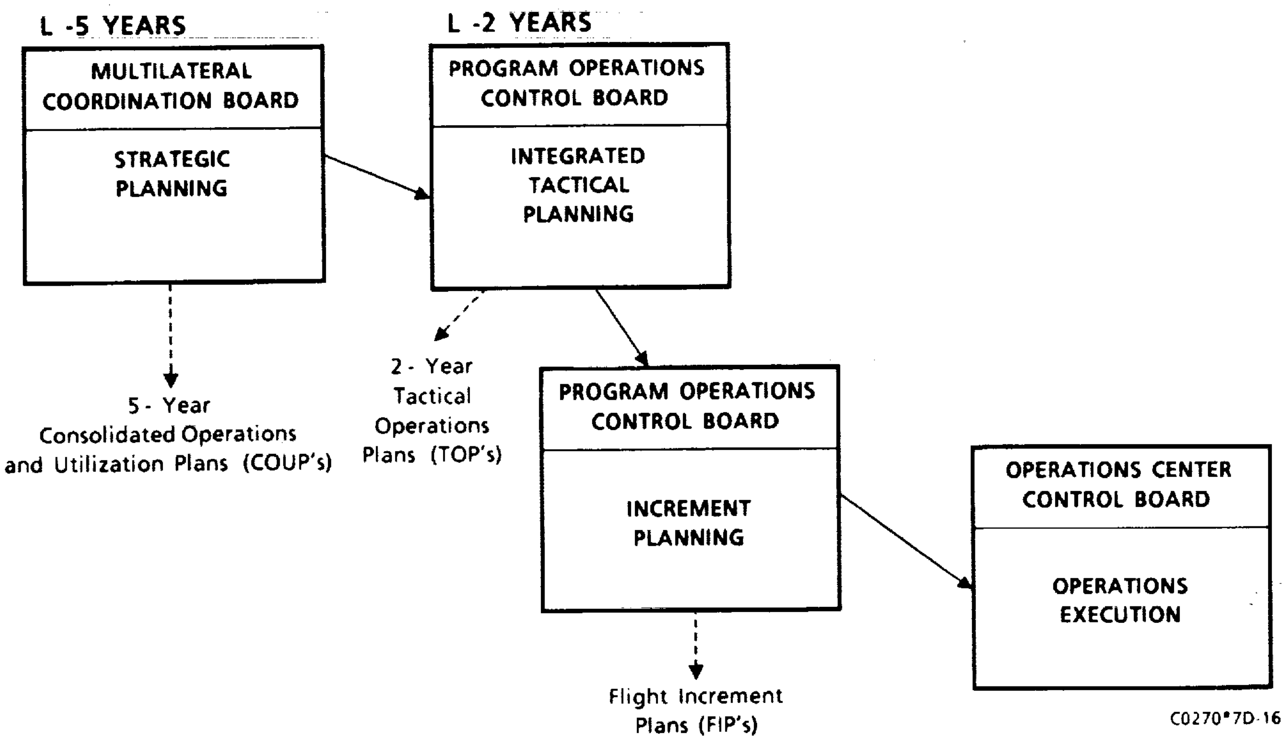

Figure 4. Space Station Operations Control Process

4.2.1 Strategic Planning

Strategic planning will be under the control of a Multilateral Coordination Board (MCB) with representative membership from NASA, ESA, Japan, and Canada. The primary task of the MCB will be to approve the Station utilization plans and system operations plans and deliver them to the tactical planning level. User boards from each of the four International Partners will submit Space Station utilization plans to the MCB's User Operations Panel (UOP). The UOP will be responsible for identification and resolution of technical or operational incompatibilities among the proposals prior to submittal to the MCB. The flow of information and relationships of these groups is depicted in Figure 5.

The MCB will operate by consensus of the International Partners, with the NASA chairman making decisions in instances where a consensus can not be reached. The principal product of the strategic planning process

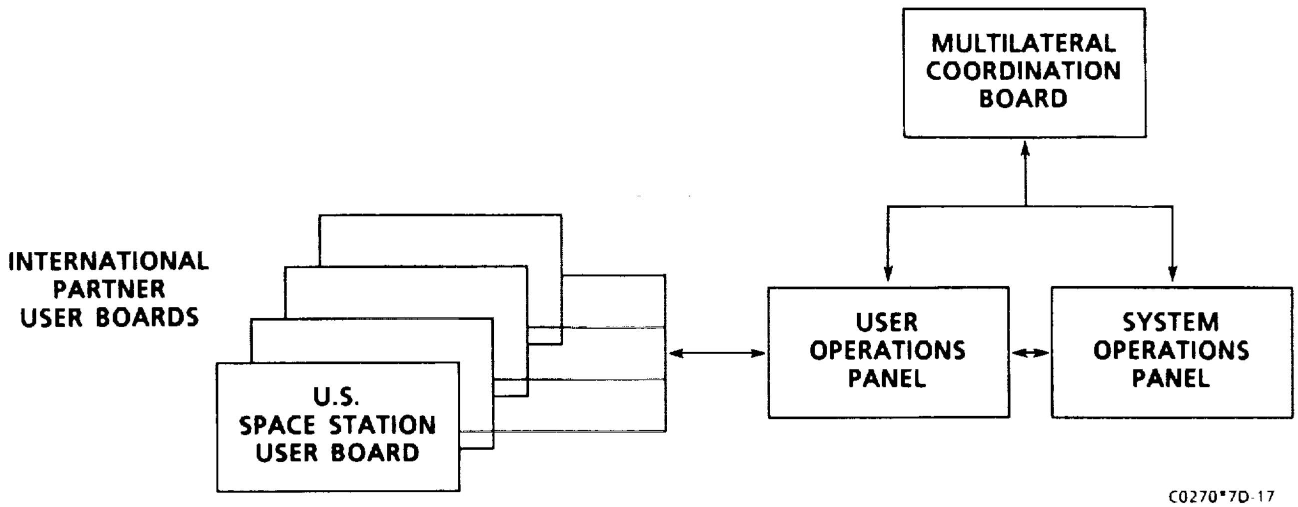

Figure 5. Space Station Strategic Planning Flow

will be a 5-year Consolidated Operations and Utilization Plan (COUP) which will be updated annually. The COUP will include a:

(1) 5-year Station and user resource allocation plan,
(2) List of selected users with year and priority assignments,
(3) List of major Station capability enhancement plans, and a
(4) 5-year transportation plan.

4.2.2 Tactical Planning

The tactical planning stage performed for a 2-year horizon will convert the COUP into a much more detailed second-level integration plan. Planning will be performed in units of flight increments, where an increment is taken as the nominal interval between Shuttle visits to the Station. This time period will be driven by crew change-out and is currently planned to be 90 days (i.e., 1/2 of the 8-person crew will be changed every 90 days). Tactical planning will be performed under the direction of the Program Operations Control Board (POCB), and the principal product will be a Tactical Operations Plan (TOP) which defines the Station manifest (e.g., payload, crew, launch vehicle assignments, etc.).

4.2.3 Increment Planning

The most-detailed planning activities take place as part of the increment planning process which is initiated 2 years prior to the beginning of the increment in question. For each increment listed in the TOP, an Increment Change Manager (ICM) is assigned along with an increment support team. The Flight Increment Plan addresses launch site processing, crew and flight controller training, crew activity, payload-to-Station Interface Control Documents (ICD's), etc. The Flight Increment Plan, which will evolve over its 2-year life, serves as the central source of direction to the Station execution organization.

4.2.4 Operations Execution

Operations execution will be the joint responsibility of the Space Station Control Center (SSCC) and the Payload Operations Integration Center (POIC). The SSCC will have responsibility for real-time Station systems planning and operations (including real-time resource allocations), while real-time user planning and operations will be the responsibility of the POIC. It is expected that selective science user representatives will be located at the POIC but that the majority of users will be linked electronically from remote sites.

4.3 THE TRADITIONAL SCIENCE OPERATIONS PROCESS

Based on almost 3 decades of successful space science programs, a proven methodology for the planning and execution of such programs has evolved. This methodology, or science operations process, consists of activities which may be organized into the following four functional phases:

(1) Science Planning and Payload Selection,

(2) Payload Development and Integration,

(3) Science Tactical and Increment Planning (traditionally called Mission Planning), and

(4) Science Operations and Data Management.

The following sections of this report describe each of these functional phases.

4.3.1 Science Planning and Payload Selection

The first phase in the science operations process is science planning and payload selection. Figure 6 provides an illustration of the detailed activities which comprise this functional phase, the external guidelines by which these activities are governed, and the principal products which are produced.

This phase sets the stage for all subsequent activities. It includes activities which determine the scientific priority of the programs proposed for the Station, ensure that the Station is the optimum site for these studies, and validate the technical approach proposed for the programs. This phase is also critical in the development of the rationale for the request of funds to develop, operate, and maintain the planned instruments and facilities and in the allocation of adequate Station resources to support them.

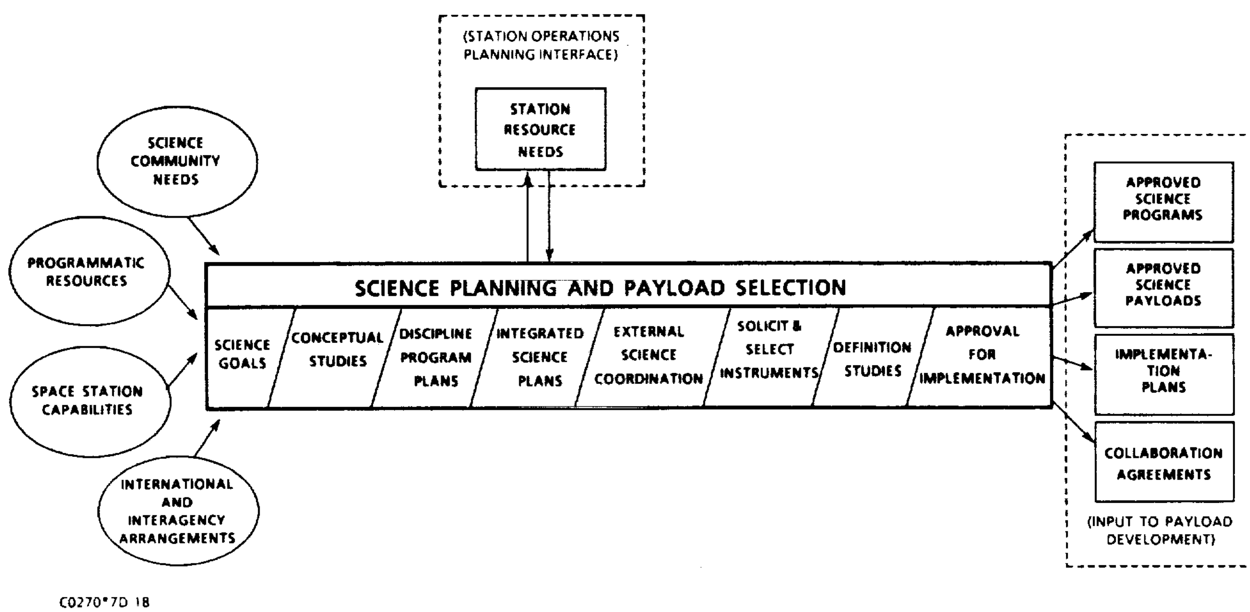

Figure 6. Science Planning and Payload Selection

It is during this phase that most international and interagency agreements are made on cooperative programs and on the sharing of data or facilities. Requirements are also identified for new ground systems, new data systems, new standards, or for modifications and upgrades to existing flight systems, including those that are part of the Station itself. New instruments and facilities are selected for development to provide the capabilities to conduct the planned science programs. Finally, implementation plans are developed to ensure that the new and modified flight and ground systems, including the new science instruments, are available when required.

4.3.2 Payload Development and Integration

The payload development and integration phase of the science operations process converts program guidelines and groundrules, established in the science planning and payload selection phase, into action and produces the flight and ground hardware and software systems necessary for operations execution. Payload system operational characteristics, requirements, and capabilities are also established and serve as inputs to the tactical and increment planning phase. There is an extremely strong coupling between payload development and science tactical and increment planning, with considerable overlap in the skills and knowledge needed to support both sets of activities. While for the purposes of presentation this document treats the two sets of activities serially, they actually overlap in time and should not be viewed as independent and separable activities. Figure 7 depicts the inputs to payload development and integration, the activities of which it is comprised, and the outputs of the process.

4.3.3 Science Tactical and Increment Planning

The science tactical and increment planning phase of the science operations process is quite comparable to that set of activities referred to as "mission planning" for current Spacelab programs. However, in that there will not be discrete Space Station missions (Station operations will

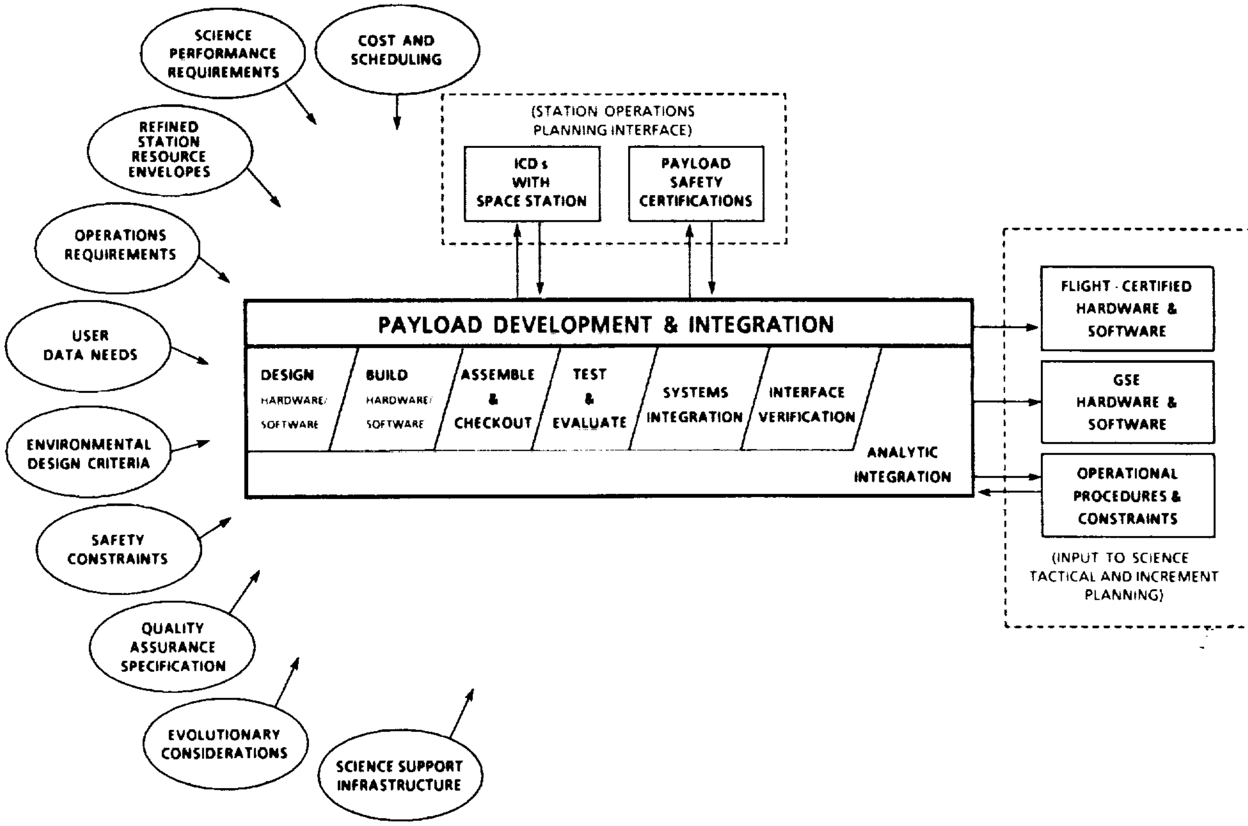

Figure 7. Payload Development and Integration

be continuous), the term science tactical and increment planning is used to maintain consistency with Space Station terminology.

The tactical planning portion of this phase consists of the development of top-level program strategies pertaining to payload priorities and related manifest decisions. These strategies, developed in concert with Space Station considerations, yield compatible groupings of science payloads and specific increment assignments for these payloads. The increment planning portion of this phase takes the knowledge gained from the payload development activities and uses that knowledge to develop the detailed plans and procedures necessary for increment operations execution. Figure 8 depicts the inputs to science tactical and increment planning, the activities of which it is comprised, and the products of those activities.

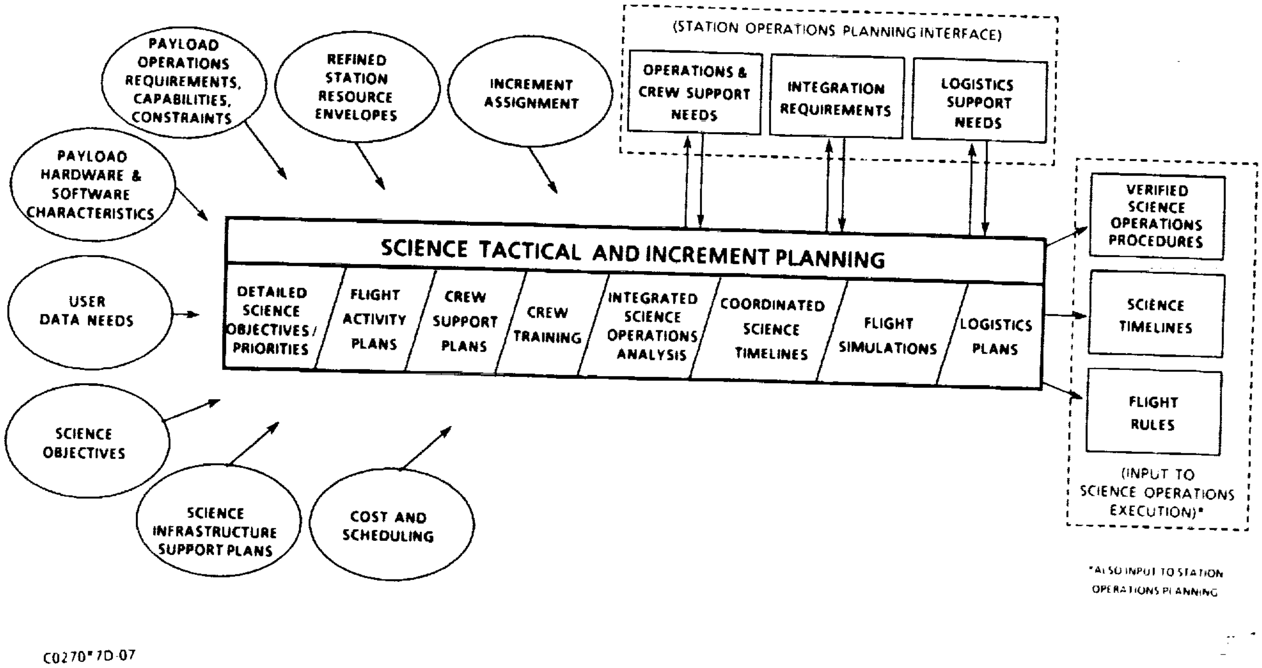

Figure 8. Science Tactical and Increment Planning

4.3.4 Science Operations and Data Management

The operations and data management phase of the science operations process produces the "payoff" for all of the preceding activities. It enables the Principal Investigators (PI's) and facility developers to demonstrate that they have achieved the planned levels of instrument performance and that this level of performance is adequate to realize the scientific objectives defined for their instruments. This phase facilitates the long-term operation of these instruments through ground return and refurbishment or through on-orbit maintenance and servicing. It enables a multiplicity of users to conduct investigations or experiments with the instruments, under ground control or with the assistance of the crew. Finally, PI's and users alike are provided with the data and samples that they need to conduct their proposed research, and a bank or archive of data and samples (available to future researchers in the field) is produced.

Figure 9 shows the complete range of activities of which this phase is comprised, together with the inputs and outputs of the process.

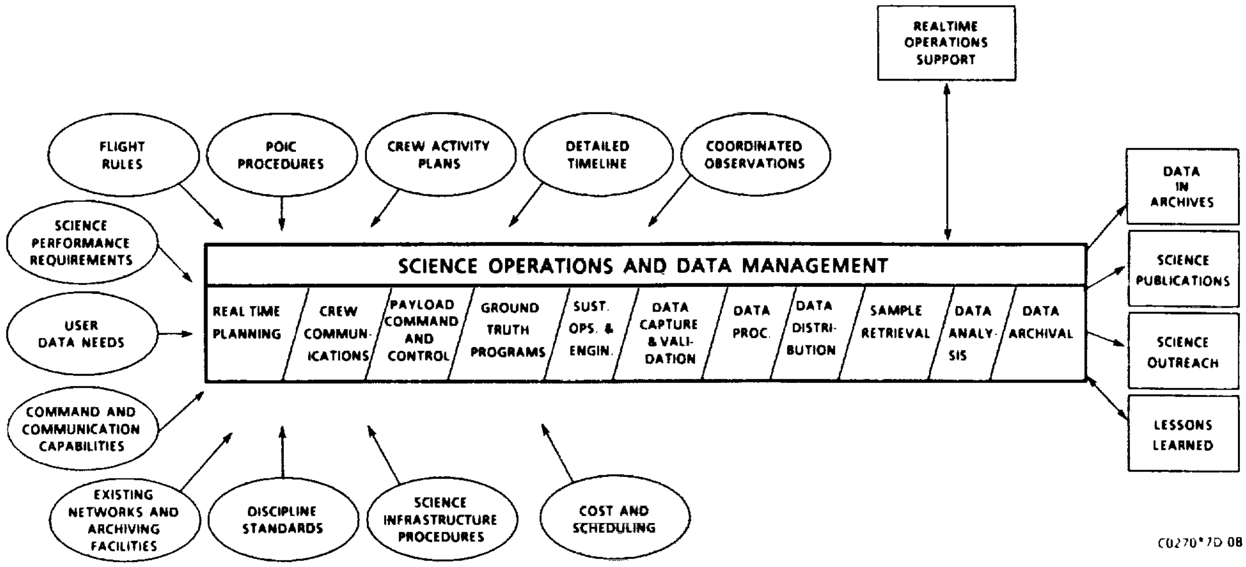

Figure 9. Science Operations and Data Management

4.4 INTEGRATED OPERATIONS

Figure 10 couples the traditional science operations process with the Space Station operations control process. The figure illustrates, in a time-consistent manner, the parallel flow of activities for science operations and Space Station operations. Consistent with the emphasis of this document, a finer degree of granularity is presented for the science operations flow. For the purposes of this figure, the payload development and integration activity is begun approximately 4 years prior to launch. Such a schedule is felt to be reasonably representative of Space Station payloads, but, dependent upon the nature of the payload, considerably more or less scheduled time could be required. Shown between the two flows are the negotiated agreements, joint documents, and shared responsibilities in which the two processes are brought together.

The science operations and Space Station operations flows grow closer with time, reflecting the real need for the flows to blend ultimately into a single, unified operation. In the earliest phases of the two flows, integrated science plans need to be in accordance with the coarse allocation of long-term Space Station resources established by Space Station strategic planning. With time, the allocation of Space Station resources has to become more precise. Upon finalization of science implementation plans and prior to the start of payload development, more specific resource envelopes are needed for individual payload projects.

During payload development, detailed Interface Control Documents (ICD's) should be established between the science user and Space Station organization. Certification of payload safety compliance represents another required confluence of efforts which should occur during payload development.

During the tactical and increment planning phases of the two flows, plans for transportation, ground integration, increment assignment, and detailed operational timelines are mutually developed. When the flows have progressed to the launch and operations execution phases, they are blended into a single, coordinated operation.

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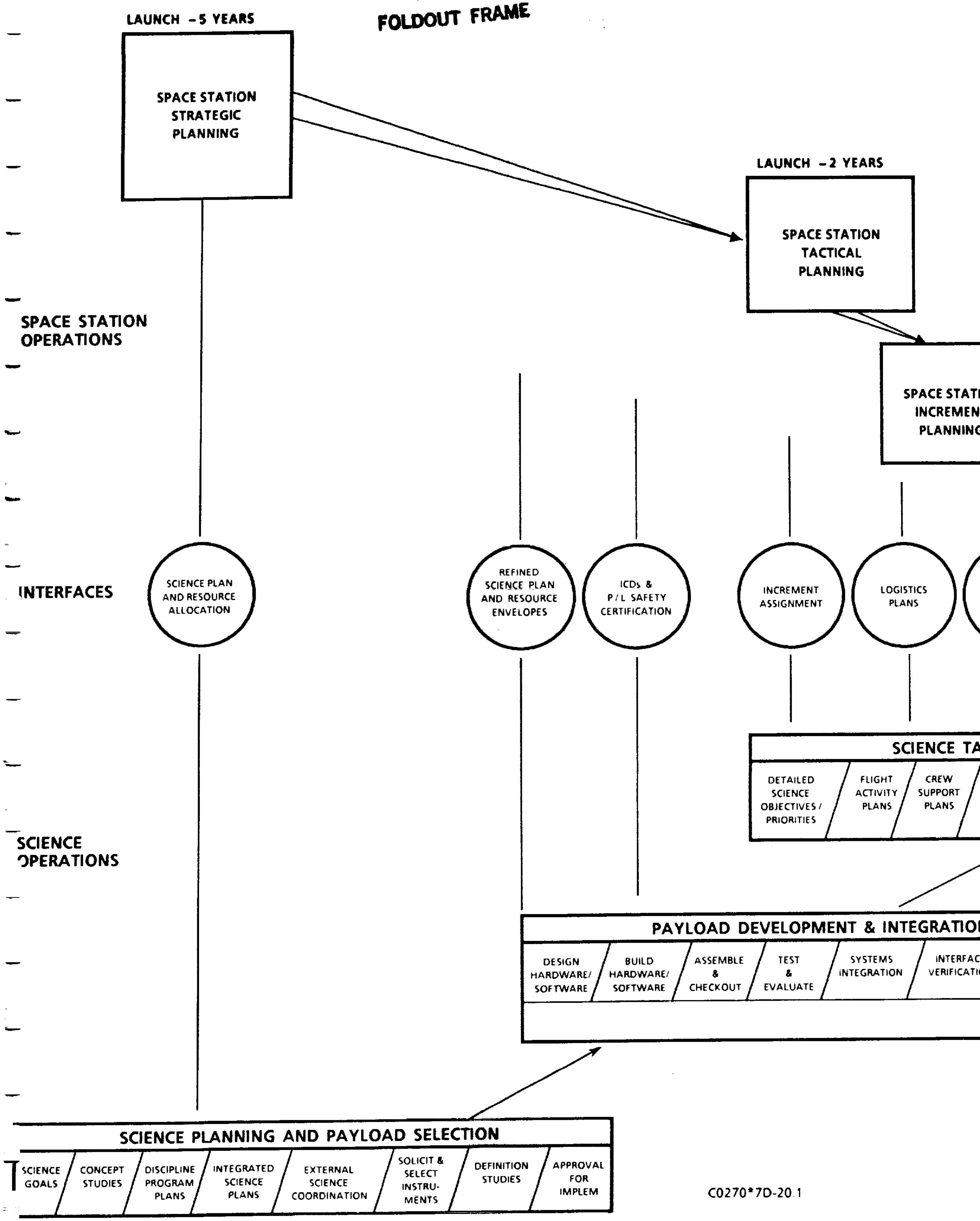

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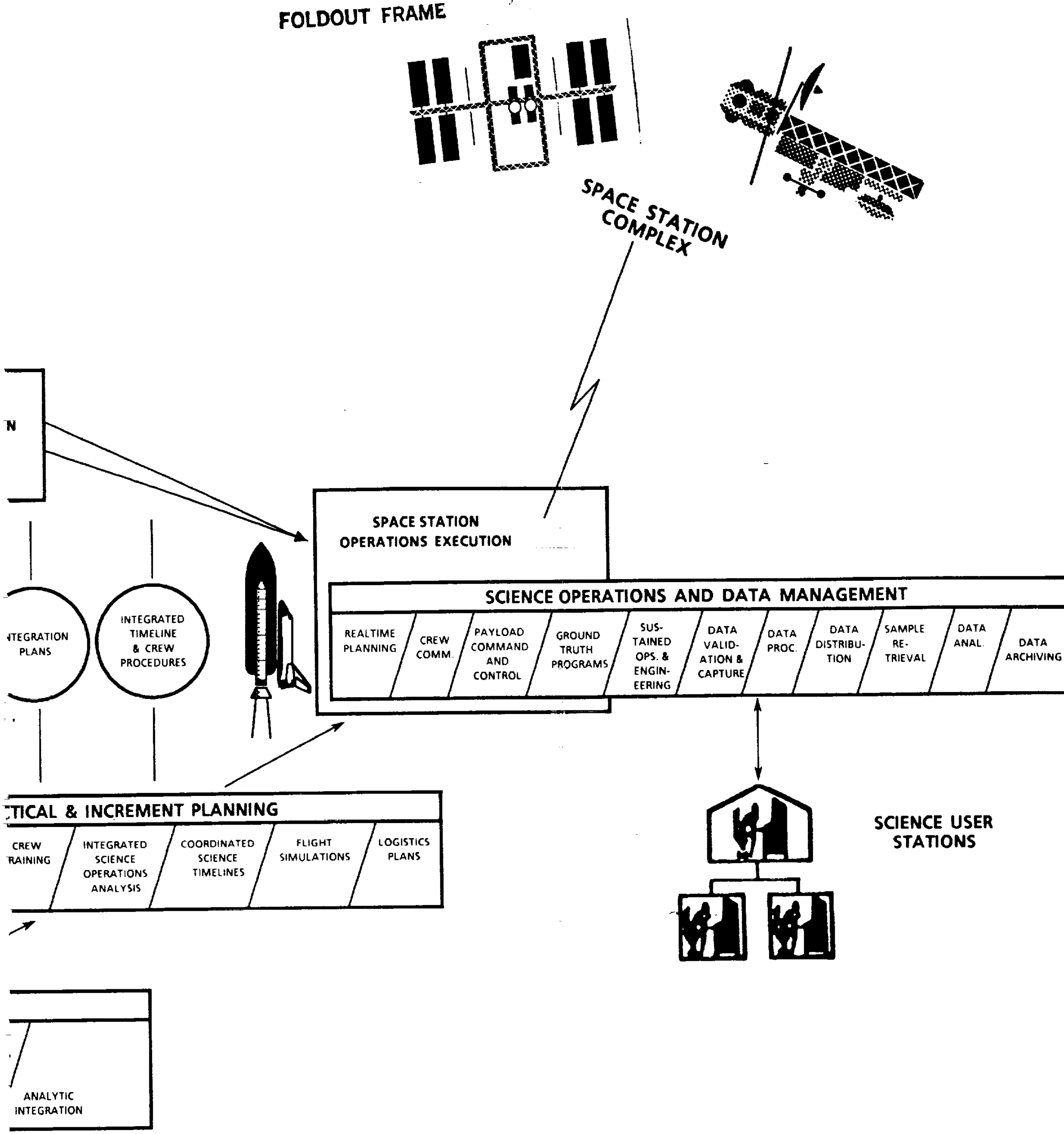

Figure 10. Space Station Science Operations

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CHAPTER 5
SCIENCE MANAGEMENT ARCHITECTURE

5.1 INTRODUCTION

This chapter identifies and establishes the top-level management framework for the utilization of the Space Station by the U.S. science community. The management framework presented assigns responsibility for coordinating and focusing all U.S. science uses of the Space Station to NASA/OSSA and, at the same time, accommodates substantial participation by other U.S. Government agencies.

This plan represents the normal, but not the only possible, "path" to the Station. The framework and process presented is intended to cover utilization from within the resource envelope allocated to U.S. science and applications users. Special situations may arise in which U.S. science and applications users participate in Station utilization outside of this resource envelope, such as a direct appropriation from Congress to a single agency or an agency collaboration with an industrial partner in which commercial space is purchased. For such situations, the agency involved may or may not elect to use the procedures defined in this plan.

It is anticipated that utilization of the Space Station will be governed by policies established at the highest levels of the Federal Government. It can be expected that these policies will be imposed on science users in a top-down process. However, the planning and execution of science utilization activities within the "boundary conditions" set by such policies will be a bottom-up process in which science goals and plans germinate directly from within the science community. The management architecture described in this chapter is intended to facilitate this bottom-up process.

Management mechanisms for the coordination of interagency science plans and programs are presented, international coordination is discussed, and individual agency management structures are presented. The chapter concludes with a discussion of the science community's role within the overall management framework.

As discussed in Chapter 4, Station operations will be planned and scheduled in units of flight increments. This "management-intensive" approach, although appropriate, is somewhat at odds with the desire for continuous, long-lived, and uninterrupted science operations. Consequently, it is intended that the management framework presented in this document provide a means of buffering the science user from the management formalities of the increment process.

5.2 INTERAGENCY COORDINATION

In adherence with the principles of cooperation presented in Chapter 3 of this plan, it is important that there be adequate mechanisms for the close coordination of science plans and programs among the various science agencies.

Figure 11 presents a simplified characterization of the process for the strategic coordination of agency science programs and plans. As shown, science coordination will be accomplished in a bottom-up planning process. In this process, multiagency Discipline Working Groups (DWG's) will develop and propose science goals and priorities. Agency discipline offices will consider the proposed goals and priorities, accept or modify them as appropriate, and extrapolate the finalized goals and priorities into specific discipline plans. The discipline offices from each agency, active in a particular discipline, will then work together to develop an overall coordinated discipline plan. (The plans of an individual discipline office within a given agency may need to be modified as a result of this coordination process.) As implied in the figure, OSSA will serve as the focal point for the integration of the various coordinated discipline plans into an overall, coordinated, multiagency, multidisciplinary plan. This plan will be submitted to the Space Station Science and Applications User Board (SSSAUB) for approval and formal submittal into the overall Space Station strategic planning process.

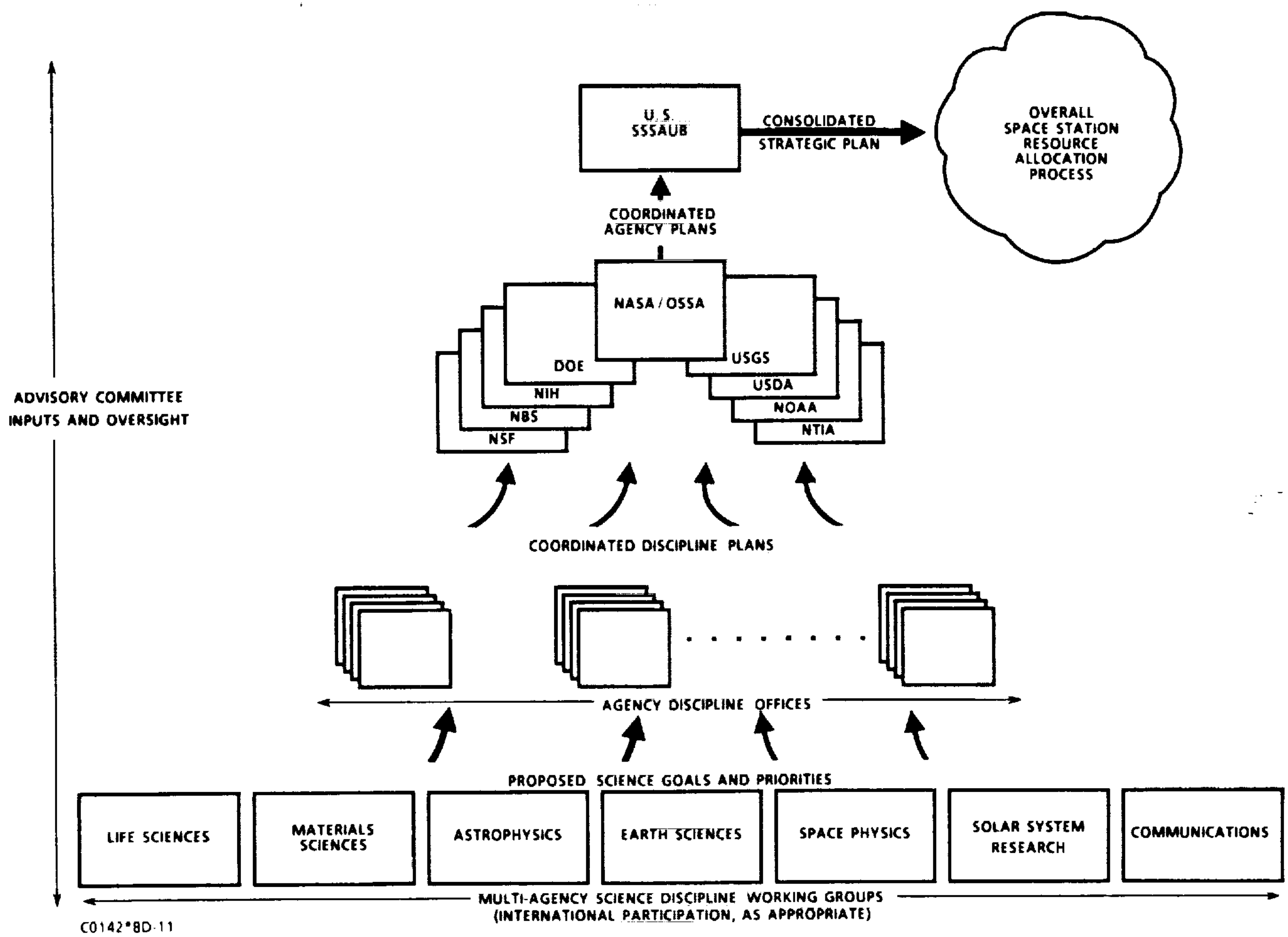

Figure 11. Bottom-Up Formulation of Space Station Science Strategic Plans

5.2.1 Discipline Working Groups

Figure 11 is not intended to present a precise DWG organizational structure but rather to convey the basic DWG role in the overall planning process. (Within a given discipline, it is quite likely that several sub-discipline working groups might be needed and that existing working group structures can be applied to Space Station planning.) DWG members will consist of scientists from the Federal Government and the external science community and representatives from the International Partners, as appropriate. Members will be selected by the agencies which intend to be active in that particular science discipline. These groups will propose science goals and strategies for the scientific utilization of the Space Station for their science discipline and will provide coordinated guidance to their parent agencies. Hence, individual DWG's will be the principal mechanism for the grass-roots coordination of science programs and plans among and between the participating federal agencies.

OSSA will take the lead in establishing the DWG's, but the direction and operation of the groups will be determined by the groups themselves. It should not be inferred that OSSA will necessarily play the dominant role in all disciplines. In fact, another agency might elect at some point to establish a new DWG in a science area in which OSSA is not involved.

5.2.2 Agency-Level Coordination

The science goals and priorities developed by the DWG's will be delivered to the appropriate agency discipline organizations. A given DWG will provide coordinated science guidance to all of the agencies active in its particular discipline. Individual discipline offices will give strong consideration to the goals and priorities proposed by the DWG in the development of specific discipline programs and plans. Agencies' discipline organizations will work together to coordinate and integrate complementary plans and programs. (Since the discipline guidance provided to the different agencies by the DWG's will be mutually compatible and synergistic, the coordination and integration process should be greatly eased.) OSSA, via its Flight Systems Division, will assume the lead responsibility for consolidating the different discipline-level plans into an overall, coordinated, multiagency, multidisciplinary plan. This process will, of course, be iterative in nature and will involve all discipline organizations. The final multiagency plan will be submitted to the SSSAUB.

5.2.3 Space Station Science and Applications User Board

The SSSAUB will be a decision-making body. It will review the proposed multiagency science plan, direct modifications to the proposed plan as appropriate, approve the plan, and formally submit the plan into the overall Space Station strategic planning process. As such, the SSSAUB will maintain overall resource allocation authority within the Space Station resource envelope available for U.S. science. The board's principal product will take the form of an annual consolidated strategic plan (with a 5-year horizon) for the U.S. science utilization of the Space Station. The science strategic plan will be submitted to the U.S. Space Station User Board (SSUB) which will be the forum for the formal allocation of Station user resources among all U.S. users (e.g., science, commercial, etc.). In the event of a shortfall in the accommodation of the science strategic plan, the SSSAUB will reallocate Station user resources among U.S. science users in an equitable manner.

Membership of the SSSAUB will consist of a single senior official from each of the participating federal agencies. The NASA/OSSA representative will be the chairman of the SSSAUB and, as such, the single U.S. science representative to the SSUB. The SSSAUB will meet one-to-two times per year, and meetings will be phased to comply with the overall Space Station strategic planning process. Technical and administrative support to the SSSAUB will be provided by OSSA, as necessary. Figure 12 shows the relationship of the SSSAUB with the other elements of the Space Station strategic planning process.

While the focus of SSSAUB activities will be on strategic planning, the group will maintain top-level oversight of all phases of the Space Station science operations process in order to enhance its strategic planning effectiveness. The full range of functions and responsibilities is outlined in the SSSAUB charter which is included as Appendix B of this plan.

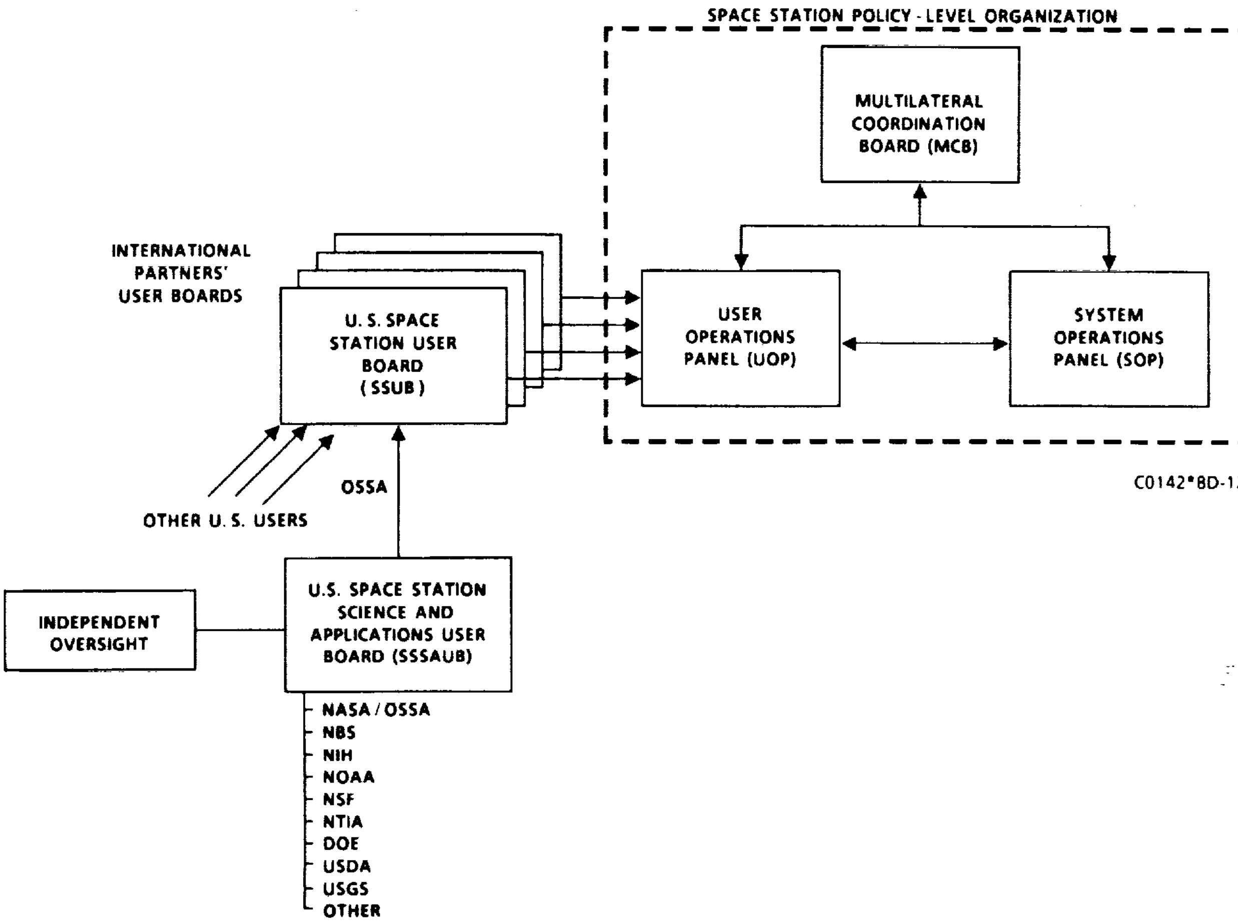

Figure 12. Management Structure for Strategic Planning

5.3 INTERNATIONAL COORDINATION

Representatives of science users from the International Partners will be encouraged to participate as members of the DWG's. With the concurrence of the other U.S. agencies active in a particular discipline, any agency may solicit the participation of international representatives for the DWG in question. As in the case of interagency coordination, international participation on the DWG's will allow a degree of synergistic planning among international science users.

A formal international board analogous to the SSSAUB will not be established, but rather the more informal and traditional coordination mechanisms (most typically exercised at the agency level) will be relied on.

As always, individual agencies will be free to collaborate with international science organizations, including those of the Space Station partners and other nations, in the development and use of scientific instrumentation and in the sharing of data. However, any such collaborations must be consistent with the resource allocation made available through the SSSAUB strategic planning process.

5.4 AGENCY MANAGEMENT STRUCTURES

5.4.1 Introduction

Each agency will develop its own internal management arrangements for planning and executing its Space Station science utilization activities. These management structures will be responsible for extrapolating the science goals and priorities developed by the various DWG's into real science programs and then integrating individual science programs into coherent plans. The agencies will then work together, with OSSA having the lead responsibility, to develop an integrated multiagency, multidisciplinary plan. Thus, the internal agency organizations will bridge the management gap between DWG's at the science grass-roots level and the SSSAUB at the policy level. Once programs are formally approved, these organizations will be responsible for detailed planning and implementation activities.

Space Station utilization represents only one of many activities in which each of the agencies is involved. For example, NASA/OSSA supports a host of other space science programs such as unmanned free-flyers, planetary probes, Spacelab, sounding rockets, high-altitude aircraft, balloons, and some limited ground-based activities. For the other agencies, Space Station utilization represents an even smaller fraction of their overall science activity, given their extensive and diverse ground-based programs. Consequently, agencies may elect not to have formal Space Station science organizations per se, but rather may apply their existing organizations to take advantage of the Space Station opportunity.

OSSA has an established space science management infrastructure which has successfully supported the traditional end-to-end science operations process for numerous space science programs for many years. This infrastructure represents a major national resource and a major national investment. It is the objective of this plan that this infrastructure not be needlessly duplicated and that it be made available to all U.S. science agencies as appropriate. For access to and use of the OSSA management infrastructure and its associated facilities and systems, quid pro quo arrangements will be developed between OSSA and the other agencies. (The nature of such arrangements is to be worked out on a case-by-case basis and is not addressed by this document.)

5.4.2 OSSA Space Station Management Structure

5.4.2.1 Introduction

OSSA has traditionally distributed management functions between its headquarters organization and its support organizations located at the various NASA field centers. The historic split of management responsibilities has been:

- OSSA Headquarters: Science policy, strategic plans, program definition/approval, and programmatic oversight/control.
- Field Centers: Project implementation including payload development, integration, and operations.

This split of responsibilities generally will remain in effect for OSSA's utilization of the Space Station. However, the project implementation function will change because science projects can not be as crisply defined for Space Station as they have been on previous programs. The ongoing and continuous nature of Space Station operations coupled with an ever-evolving complement of payloads, sponsored by a diverse set of parent organizations, makes it difficult to define discrete projects.

5.4.2.2 Headquarters

Figure 13 displays the functional relationships among various OSSA organizations involved with Space Station utilization activities. The OSSA Associate Administrator (AA), who reports directly to the NASA Administrator, will oversee OSSA's Space Station activities and will ensure that these activities are properly balanced with the overall OSSA science program. National policy guidance will be provided to the NASA Administrator by policy advisory groups such as the National Microgravity Research Board. The AA will receive, interpret, and incorporate this guidance into OSSA programs and plans. The AA also will take advantage of guidance from various science advisory groups such as the Space Station Science and Applications Advisory Subcommittee (SSSAAS). The AA will be the OSSA representative to, and chairman of, the SSSAUB. An Assistant Associate Administrator (AAA) for Space Station will be responsible for ongoing oversight of OSSA Space Station activities and will act on the AA's behalf, as appropriate.

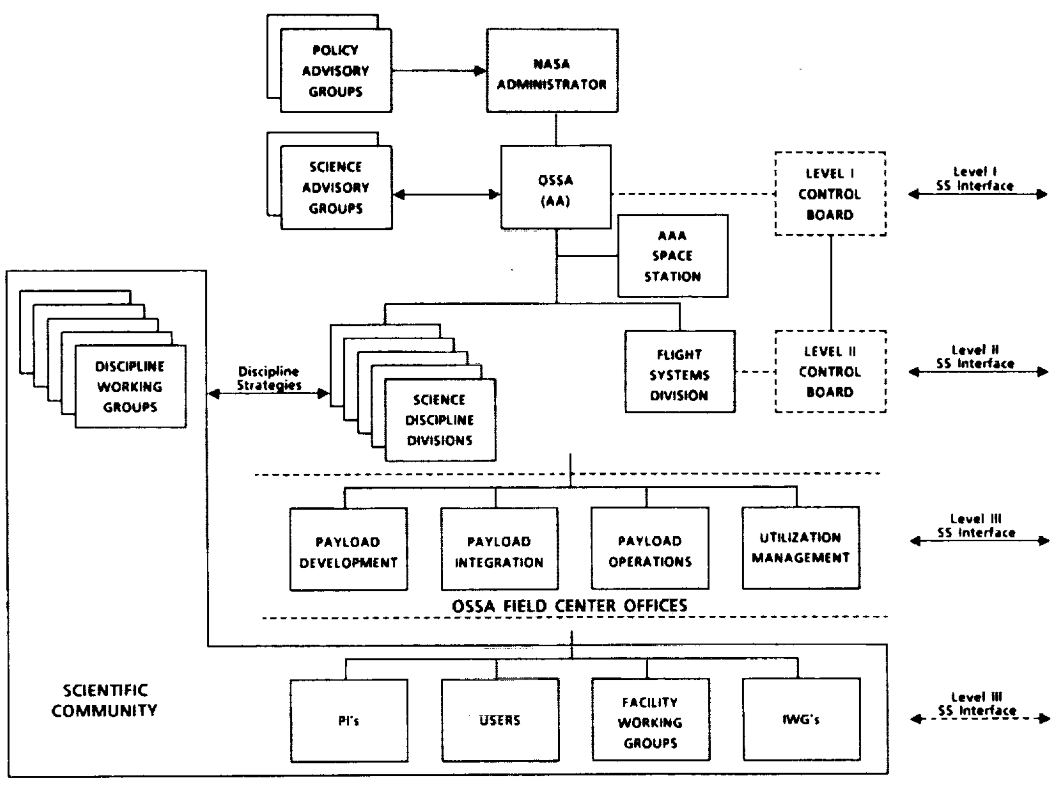

Figure 13. OSSA Space Station Management Support Structure

A Level I Control Board will establish policies and priorities, approve top-level payload requirements, and interface with the Office of Space Station Level I organization. Membership of the board will consist of the OSSA AA (chairman) and OSSA Division Directors.

The heart of the OSSA organization is its science discipline Divisions: Astrophysics, Communications and Information Systems, Earth Science and Applications, Life Sciences, Microgravity Science and Applications, Solar System Exploration, and Space Physics. To utilize the Space Station, these Divisions will:

- Define science program requirements;
- Solicit and select appropriate science instrumentation and investigations;
- Manage science instrument development using NASA field centers or other resources as appropriate;
- Coordinate science programs with other national and international groups or agencies;
- Manage the on-orbit operations and data analysis of sponsored programs; and
- Manage and develop specific assigned aspects of the OSSA Space Station program as designated (e.g., EOS).

These science discipline Division activities will reflect the goals, objectives, and priorities proposed by DWG's.

Management and systems integration across disciplines, at the headquarters level, will be the responsibility of the Flight Systems Division. This office will:

- Coordinate and integrate the interface, operations, logistics, and other accommodation requirements for OSSA programs across science discipline Divisions and represent OSSA user requirements to OSS;
- Analyze instrument development requirements relative to interface, resource requirements, reliability, etc., and prepare user handbooks and other guides for the preparation, test, and flight operation of science instrumentation;

- Represent OSSA user interests to OSS and act as point-of-contact for integrated requirements related to all phases of instrument development, operation, logistics, servicing, etc.;
- Develop, maintain, and control OSSA Space Station payload data bases for use in internal OSSA planning and for use by other NASA elements as required;
- Support OSSA science discipline Divisions in the process of solicitation, review, and selection of science payloads for Space Station as required;
- Develop requirements for common testing, integration, operations, and crew training facilities which may be required for OSSA-sponsored payloads and define and develop the capabilities as required; and
- Prepare, monitor, and assess integrated schedules for the development of payloads and interface these schedules with the relevant OSS milestones.

A Level II Control Board will approve mission requirements, maintain OSSA Space Station data bases under configuration control, and interface with OSS Level II organizations. The Flight Systems Division will provide the chairman of this board, and each science Division will provide a member.

Formal interfaces, and the split of responsibilities, between OSSA and OSS are governed by a Letter of Agreement which is included in this document as Appendix C. Given the importance and complexity of the overall Space Station information system, a separate Memorandum of Understanding (MOU) has been developed to establish interfaces and responsibilities of OSSA, OSS, and the Office of Space Operations (OSO). This MOU is included in this document as Appendix D.

5.4.2.3 Field Centers

Management responsibility for the major implementation functions of payload development and integration, operations planning and execution, and utilization management will be distributed among the various OSSA support offices within the NASA field centers. A number of management arrangements will be used to service the needs both of disciplines and individual projects. Figure 14 presents a menu of possibilities from which OSSA can draw for field center support for its Space Station utilization activities. Included in the figure is the list of field centers which OSSA will call on and the types of management and technical support capabilities that these centers will make available. (The information included in this figure is not intended to be all-inclusive nor is it expected that such a matrix of possibilities will remain fixed.) Management assignments will be levied on the different field centers by both the OSSA science discipline Divisions and the Flight Systems Division.

a. <u>Field Center Support to Science Divisions</u>

The following discussion introduces the concepts of "Space Station Science and Technology (S&T) Centers"[1] and "Discipline Operations

	OSSA SUPPORT ACTIVITY	NASA FIELD CENTERS								
	Payload Development and Operations	ARC	GSFC	JPL	JSC	KSC	LaRC	LeRC	MSFC	SSC
Sponsored by OSSA Disciplines	Life Sciences	X			X	X				
	Materials Sciences			X	X		X	X	X	
	Astrophysics	X	X	X					X	
	Earth Sciences	X	X	X			X		X	X
	Space Physics		X	X					X	
	Solar System Research	X	X	X	X					
	Communications		X	X				X		
	"Rack - Equivalent" Integration	(TO BE DETERMINED) (1)								
Sponsored by Flight Systems Division	Launch-Site Payload Processing and Integration					X				
	Multi-Discipline Utilization Management		X		X				X	

(1) Potential exists for an SSP-certified rack-equivalent integration capability at each field center. Actual implementation at specific centers is TBD

ARC - Ames Research Center
GSFC - Goddard Space Flight Center
JPL - Jet Propulsion Laboratory
JSC - Johnson Space Center
KSC - Kennedy Space Center
LaRC - Langley Research Center
LeRC - Lewis Research Center
MSFC - Marshall Space Flight Center
SSC - Stennis Space Center

Figure 14. NASA Field Center Support Capabilities for OSSA

[1]Terminology introduced by the Space Station Program and not to be confused with the Government-wide initiative to establish "Science and Technology Centers" on university campuses (Executive Order No. 12591, April 1987).

Centers (DOC's)." These terms are used to maintain consistency with terminology used in existing Space Station Program (SSP) documentation. An S&T Center roughly corresponds to an OSSA payload development office or project at a NASA field center, with the additional implication of formal SSP certification of a payload integration and verification capability. A DOC roughly corresponds to an OSSA payload operations center. S&T Centers and DOC's will be sponsored, operated, and funded by OSSA.

Assignments originating from the science Divisions will include science payload development, integration at the instrument or facility level, and operations planning and execution. The OSSA science Divisions will use a variety of strategies for field center support, with each Division using a strategy appropriate to the needs and traditions of its science discipline(s).

The microgravity disciplines of materials sciences and life sciences intend to cluster their field center support functions at the discipline level. Payload development and integration activities most probably will be clustered at one or more S&T Centers. Where appropriate, the Microgravity Science and Applications Division and the Life Sciences Division will jointly sponsor and share common S&T capabilities. Operations planning and execution will be assigned to one or more DOC's. The DOC's may or may not be incorporated into the S&T Centers.

The observing disciplines of astrophysics, earth sciences, space physics, and solar system research (in addition to the communications discipline) will tend toward the use of a more distributed approach with greater reliance on individual field center project offices. Each project office could be viewed as a combined mini-S&T Center and mini-DOC which would manage the end-to-end life cycle activities associated with individual projects.

b. <u>Field Center Support to the Flight Systems Division</u>

Assignments originating from the Flight Systems Division will include multidisciplinary systems-level integration (both physical and analytical) and multidisciplinary utilization management.

<u>The Flight Systems Division will assign a science payload experiment processing and integration function to the Kennedy Space Center</u>

(KSC). This support function will augment the user interface verification capability to be provided by OSS at KSC which assumes a "ship-and-shoot" payload delivery from an S&T Center. While a certain class of science payloads may well rely on a ship-and-shoot mode, other payloads will require assembly, alignment, functional checkout, refurbishment, and repair capabilities at the launch site. The KSC science payload integration function sponsored by the Flight Systems Division will provide such capabilities.

If the OSSA disciplines elect not to sponsor any certified S&T Centers, then this KSC payload integration function will be called on to service all OSSA integration requirements. Likewise, if the OSSA disciplines elect not to sponsor any DOC's, a single, centralized, multidisciplinary payload operations center sponsored by the Flight Systems Division (or possibly by the Communications and Information Systems Division) will be required.

Utilization management (traditionally referred to as mission or project management) encompasses those activities necessary to effectively organize individual instruments and multiple instrument-level operations into a coherent payload complement and to interface that payload complement physically, operationally, and managerially with the host facility. Since there will not be discrete OSSA missions on Space Station, the utilization management function will not be as global in nature as for most past programs for which OSSA has had total payload responsibility. However, to the extent practical, OSSA will group complementary payload elements on the Space Station, both spatially and temporally, into payload clusters in order to derive the benefits and efficiencies of centralized science utilization management.

The Flight Systems Division will assign utilization management responsibility to one or more field centers. This responsibility will entail the overall coordination and integration of all OSSA Level III planning and execution activities for Space Station. This function will be implemented via a Science Utilization Management (SUM) team consisting of:

- a Utilization Manager,

- an Integration Manager,
- a Systems Engineer,
- an Operations Manager, and
- a Science Manager.

The utilization management field center(s) will provide a cadre of personnel from which SUM teams can be staffed, along with additional technical staff support personnel.

The SUM team will provide a focused science interface with OSS's Increment Management Team. However, SUM assignments will not be directly tied to Space Station increments. While the rotation of OSS management teams on an increment basis is quite appropriate, the same is not true for SUM teams. Rather, assignment and scheduling will be based on scientific continuity, and a given team might be responsible for several consecutive Space Station increments. Lengths of assignment will be based on the continuity of the dominant science theme over a period of time along with overall workload considerations. For example, science planning might call for a heavy emphasis on materials sciences experimentation for six months followed by six months of life sciences emphasis. SUM rotations would be scheduled accordingly. In order to maintain operational continuity with the Space Station increment process, SUM rotations will be staggered to ensure a smooth transfer of responsibility.

5.4.3 Other Agencies

With reliance on the OSSA management infrastructure to facilitate their utilization of Space Station, the relevant management question concerning other science agencies becomes one of how to effectively interface with this infrastructure. As has already been discussed, the multiagency DWG's will provide the science grass-roots interface with OSSA, and the SSSAUB will provide the formal strategic-level interface.

However, these groups will not provide the working interfaces to develop and execute collaborative science programs. The management interface for developing collaborative programs will be between the OSSA science discipline Divisions and their counterparts from within the other agencies. Working initially through this interface, science utilization activities sponsored by other agencies would be subsumed directly into the appropriate elements of the OSSA management infrastructure. For example, a materials sciences experiment sponsored by NBS would be accommodated within the utilization management activity discussed in the previous section.

A collaborative biomedical program might be jointly developed by OSSA's Life Sciences Division and NIH's Office of Science Policy and Legislation. The actual program execution interfaces would be between second-level support organizations (i.e., agency field centers). Similar management interfaces would exist for collaborative programs for other agencies and other disciplines.

Appendix A presents simplified management "wiring diagrams" for each of the agencies which have endorsed this plan.

5.5 THE SCIENCE COMMUNITY

The science community will provide crucial elements of the overall management process for Space Station science utilization. The multiagency DWG's, populated by representatives of the science community, are the foundation of the overall process. Policy-level science advisory groups (e.g., the Space Station Science and Applications Advisory Subcommittee) play an important role in the formulation of top-level program plans and strategies.

The science community is heavily involved at the program implementation level. Principal Investigators (PI's) will be competitively selected to develop and operate science instruments. Facility working groups will define science facility design and operational characteristics, and science users of these facilities will be competitively selected. A variety of Science Working Groups will provide valuable guidance early in the program planning and definition phases. Once formed, the Investigators Working Group (IWG) of PI's and facility users will become a dominant element of the overall user architecture. The collective requirements of the IWG will be a prime driver for all flight operations planning and execution decisions. The S&T Centers, DOC's, and the SUM team will be the support mechanisms of the IWG.

CHAPTER 6

MANAGEMENT OF THE SPACE STATION SCIENCE OPERATIONS PROCESS

6.1 INTRODUCTION

This chapter applies the management framework presented in Chapter 5 to the end-to-end Space Station science operations process discussed in Chapter 4. In that OSSA will coordinate all U.S. science uses of the Space Station, Chapter 6 assumes an OSSA perspective with much emphasis placed on internal OSSA management activities. The internal management activities of other agencies are not discussed in detail other than to identify management interfaces with OSSA and entries into the science operations process via the OSSA management infrastructure.

While this chapter presents the application of the management framework to each of the four phases of the process in sequential fashion, it should be recognized that the phases will overlap and interact for any given project. Further compounding the situation is the fact that multiple projects will be active in various stages of the four phases of the process at any given time.

Consequently, the following discussions should be merely viewed as representative scenarios and not as <u>the</u> management approach. In fact, a variety of management approaches will be needed to best take advantage of the science opportunities afforded by the Space Station.

However, the general evolution of management focus as a project moves through the different phases of the entire science operations process will be similar for most Space Station science projects. Figure 15 presents this evolution. Initially, management focus will reside at the Headquarters level during the science planning and payload selection phase and then transition to a field center focus during the subsequent stages of the process. (In the case of the NASA Microgravity Science and Applications Division, which is a relatively young participant in space research, it can be expected that, at least initially, a greater degree of management control will be maintained at Headquarters.) As shown, the science community will have an active and influential voice throughout the entire process, initially via the DWG's, then through Principal

SPACE STATION SCIENCE OPERATIONS PROCESS

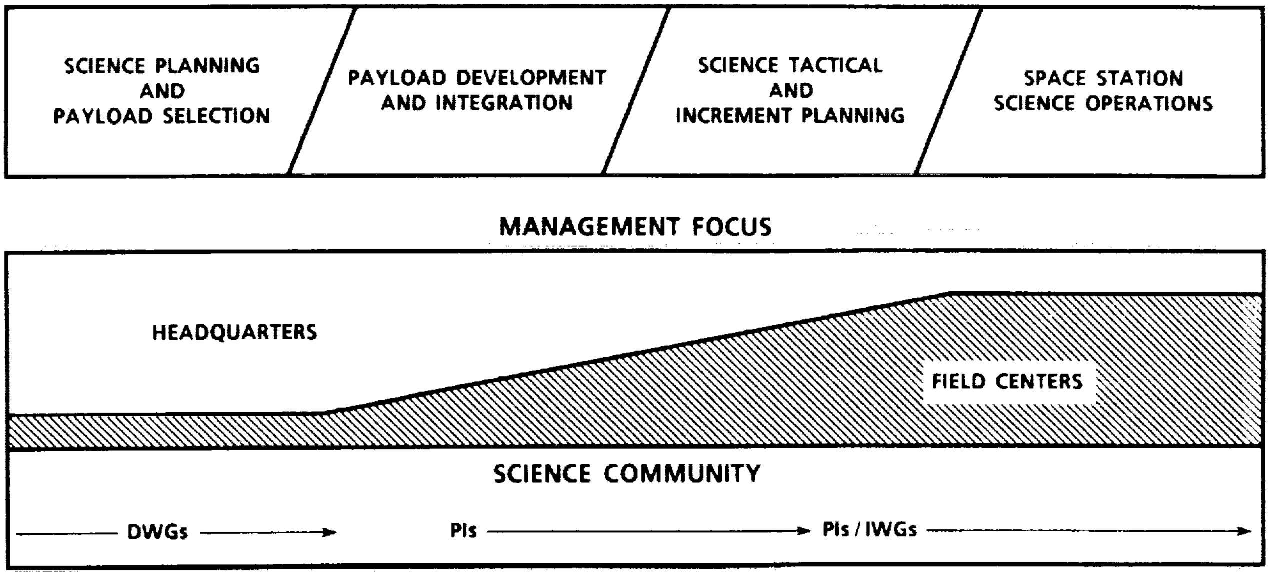

Figure 15. Typical Evolution of Management Focus During Space Station Science Operations

Investigators, and finally by Investigators Working Groups (IWG's) once payload complements are established.

6.2 SCIENCE PLANNING AND PAYLOAD SELECTION

6.2.1 Science Planning

The nominal approach to science planning for Space Station science utilization for all disciplines can be outlined by the following simplified sequence of steps:

(1) DWG's will develop and propose science goals and will identify those goals applicable to the Space Station opportunity. Recommendations concerning Space Station utilization will be submitted to their sponsoring agencies.

(2) Discipline offices, in consideration of DWG proposals, will formulate program concepts.

(3) Agency field center offices will be directed to conduct conceptual studies to identify alternate program technical approaches.

(4) Science discipline offices will integrate promising project concepts into discipline plans consistent with science priorities and available resources.

(5) Agency discipline offices will work together to develop coordinated discipline plans. The OSSA science discipline Divisions will then assume responsibility for representing overall discipline requirements.

(6) The OSSA Level II Control Board will combine the discipline plans into a recommended Space Station strategic plan for U.S. science and applications. Technical support for this activity will be provided by the Flight Systems Division (plus field center support as needed). The OSSA Level I Control Board will review, modify as appropriate, and approve the plan.

(7) The resulting science and applications strategic plan will be submitted to the SSSAUB which will review, direct modifications as appropriate, approve, and formally submit the plan into the overall Space Station strategic planning process.

Throughout these steps, the science discipline Divisions will coordinate plans with international organizations as appropriate.

6.2.2 Payload Selection

Payload selections for Space Station will be made in the context of overall OSSA payload selection plans. Solicitations may be multidisciplinary or discipline-unique and may be carried out in conjunction with other agencies. A variety of solicitation and selection vehicles will be used (e.g., Announcements of Opportunity, Dear Colleague Letters, and NASA Research Announcements) in order to maintain flexibility and to take advantage of the variety of opportunities afforded by the Space Station. New solicitation methods may also be developed to facilitate Rapid-Response Research. Formal selection authority will reside with the AA in the case of major solicitations, with the science Division Directors for more modest solicitations, and possibly with a multidisciplinary committee appointed for the selection of Rapid-Response Research.

The science community will participate in the selection process. Solicitations and selection strategies will be reviewed with the DWG's, and scientific peer review will be an integral element of all competitive selections.

6.3 PAYLOAD DEVELOPMENT AND INTEGRATION

6.3.1 Payload Development

Three different classes of science instrumentation are planned to be flown on the Space Station:

(1) Multiuser research facilities which have been identified with science community support/advice and will be developed by the Government for use by this community;

(2) PI-developed instruments which will transition to multiuser facilities, usually with a continuing PI support role; and

(3) Small (low-cost) PI-developed instruments which may be used with a major facility or flown as independent elements.

The first class of instrumentation is the preference of the microgravity disciplines of Materials Sciences and Life Sciences. For this class of instrumentation, development responsibility will be assigned to a field center payload development office (which may or may not be an S&T center) with the appropriate scientific and engineering capabilities. It is anticipated that centralized management control for all facility developments will be maintained within the appropriate OSSA science discipline Division in order to preserve a strong disciplinary orientation.

The second and third classes of instrumentation are generally preferred by the observing disciplines (Astrophysics, Earth Sciences, Solar System Research, Space Physics, and Communications) for their attached payloads, platform payloads, or small-carrier payloads. These disciplines will employ a more distributed management approach for the development of their hardware with management control primarily residing within selected project offices at the field centers. Actual development will be performed by PI's with management oversight from the field center project offices.

Payloads sponsored by other science agencies will normally be developed by those agencies. Under special circumstances, arrangements for OSSA to manage such developments will be made on a case-by-case basis. In such cases, the applicable management approach described above will be employed.

6.3.2 Payload Integration

Payload integration and test will take place at the instrument (or facility) level, at the payload system level (e.g., experiment-to-rack or instrument-to-pointing system), and at the payload-to-host system level (i.e., payload-to-launch vehicle and payload-to-Space Station).

Instrument-level integration and test will be the responsibility of the hardware development organization, most probably an S&T Center (or its contractor) in the case of a facility development and the PI's institution in the case of a PI instrument. Most typically, management oversight of the integration function will primarily reside with the OSSA science discipline Division in the case of a facility development and with the field center project office in the case of a PI instrument.

Integration at the payload system level may be carried out at a user S&T Center certified by the SSP. In such instances, payloads may be delivered directly from the S&T Center to Space Station-provided integration facilities at KSC to be accommodated in a "ship-and-shoot" mode. However, in most instances, it is expected that science payloads will be delivered to the OSSA-sponsored experiment processing facility at KSC for final payload system-level integration, servicing, and functional testing of selected experiments prior to "hand-over" to Space Station integration facilities. Payload integration into the host system (i.e., launch vehicle and the on-orbit Station) will be under the management control of the SSP in all cases.

The integration approaches and capabilities described above for OSSA science instrumentation will also be made available to support the science instrumentation of the other agencies. Arrangements for such will be negotiated between OSSA and the sponsoring agency.

6.4 SCIENCE TACTICAL AND INCREMENT PLANNING

6.4.1 Tactical Planning

Science tactical planning will involve scientific, engineering, and management considerations. It will be a multidisciplinary activity and must involve many organizations. Working closely with the OSSA science discipline Divisions, the Flight Systems Division will be responsible for coordinating overall science tactical planning. The Flight Systems Division will draw on field center offices with broadly based multidisciplinary utilization management capabilities to provide engineering and systems analyses support for tactical planning. The mission management center(s) will interact with the S&T Centers supporting the science discipline Divisions in payload development and integration.

A primary objective of science tactical planning will be to develop compatible groupings of science instruments which can be spatially and temporally clustered on the Space Station within the resource envelope allocated to U.S science. Such an approach will create "mission-like" science operations and allow for integrated management efficiencies as opposed to numerous independent and uncoordinated science operations.

The Flight Systems Division will submit recommended tactical plans (payload manifests for upcoming flight increments) to the OSSA Level II Control Board which will ensure consistency with science priorities and equitable treatment for all disciplines. Final approval authority will reside with the OSSA Level I Control Board which will formally submit the science tactical plan to the SSP for incorporation into the overall Space Station tactical planning process.

Upon formal approval of the Tactical Operations Plan (TOP) by the SSP, the Flight Systems Division will assign the integrated science management function to a field center office. This office will then form the necessary number of Science Utilization Management (SUM) teams to provide integrated management for all U.S. science activities included in the TOP. As indicated in Chapter 5, the number of teams will be determined by scientific continuity and workload and not by the number of Space

Station increments. The SUM team will serve as the focal point for integrated science considerations for all U.S. science instrumentation and experimentation. The team will be the principal management interface between the Space Station and the entire network of discipline payload development organizations.

6.4.2 Increment Planning

Detailed increment planning probably will be performed by the S&T Centers for the microgravity disciplines and by the field center project offices for the observing disciplines. Management integration of the plans produced by these organizations will be the responsibility of the SUM team described in the previous section. This team will be responsible for developing, maintaining, and implementing integrated science plans. It will serve as the linkage between the continuous and long-term plans of the science disciplines and the discrete Space Station increment system. The team will work closely with the Investigators Working Group (IWG) to ensure that all science needs are adequately addressed.

Any instrumentation or experimentation sponsored by other science agencies will be incorporated directly into all increment planning activities.

6.5 SCIENCE OPERATIONS AND DATA MANAGEMENT

6.5.1 Science Operations

All disciplines will have field center (or possibly external) organizations dedicated to the execution of on-orbit operations. Such organizations will take the form of Discipline Operations Centers (DOC's). The microgravity disciplines probably will have centralized operations with a high concentration of discipline activities clustered into a small number of DOC's. The observing disciplines, on the other hand, can be expected to use a more distributed approach with more (but smaller) "mini-DOC's" which function at the subdiscipline or project level.

All science DOC's will tie into the Payload Operations Integration Center (POIC), the central location for the real-time coordination of all Space Station payload activities. Science users will conduct operations from the various DOC's or from remote sites linked electronically to a DOC. During real-time operations, the SUM team will coordinate integrated user activities with the POIC and will support the IWG in representing the overall interests of all U.S. science users.

Users sponsored by other science agencies will be accommodated via the appropriate DOC. These users will be members of the IWG, and their interests will be represented at the POIC by the SUM team.

6.5.2 Science Data Management

The initial processing of data and the distribution of returned samples will be managed by the DOC's for all disciplines. Once data or samples are delivered to the science users, the analysis and the archival storage of such data or samples will be the responsibility of the science users under the management oversight of the appropriate OSSA science discipline Division. Such activities may be facilitated by using the DOC's for interactive analysis employing the same electronic network used for operations execution. Other science agencies may manage their own data and sample analysis and archival storage activities or may elect to collaborate with the appropriate OSSA science discipline Division.

6.6 PLATFORMS

The management of science operations for Space Station platforms will conform to the standard framework of Space Station activities discussed in this chapter. However, the overall management process will be greatly simplified in that the planning and execution of platform operations can be carried out with a high degree of autonomy. Overall operations will be similar in nature to that of traditional free-flying observatories. Beginning with payload development, management responsibility will be strongly focused within a field center project office which reports to the appropriate OSSA Division.

APPENDIX A
AGENCY SCIENCE GOALS AND MANAGEMENT STRUCTURES

A.1 INTRODUCTION

Since OSSA will assume the lead role in the coordination of all U.S. science utilization of the Space Station, the focus of this SSSAUP is on internal OSSA management considerations. The intent of this appendix is to provide additional science and management information on the other U.S. science agencies which plan to use the Space Station. Each agency's planned utilization of the Space Station, by science discipline of interest, is presented in Figure A-1.

The following sections contain a summary of goals and objectives associated with the disciplines identified by each agency. If defined, implementation concepts for Space Station utilization are also provided, along with an organizational overview identifying which organizational elements will be responsible for Space Station activities. All of this information is preliminary; it will change as these agencies' plans to sponsor research at the Space Station continue to evolve and mature.

	NASA	NBS	NIH	NOAA	NSF	NTIA	USDA	USGS	DOE
LIFE SCIENCES	X		X		○		X		
MATERIALS SCIENCES	X	○	○		○		○		○
ASTROPHYSICS	X	○			○				
EARTH SCIENCES	X			X	○		X	X	X
SPACE PHYSICS	X			X	○				
SOLAR SYSTEM RESEARCH	○				○				
COMMUNICATIONS	○			○	○	○			
OTHER		○		○	○				

NOTE: This matrix is merely intended to be representative of the range of agency interests in utilizing the Space Station.

X - Major Area of Planned SS Utilization
○ - Secondary Area of Planned SS Utilization

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Figure A-1. Science Agencies' Discipline Plans

A.2 NATIONAL BUREAU OF STANDARDS

A.2.1 Management Plans

The National Bureau of Standards' (NBS') policy oversight for issues related to the Nation's space program is located within the Office of the Director of NBS. The current NBS representative on the Space Station Science Users' Management Committee (SSSUMC) and the Space Station Science and Applications Advisory Subcommittee (SSSAAS) is the Deputy Associate Director for Industry and Standards.

The functional relationships among the major organizational units of the NBS are presented in Figure A-2. The Directors of these four technical units - the National Measurement Laboratory, the National Engineering Laboratory, the Institute for Computer Sciences and Technology, and the Institute for Materials Science and Engineering - have broad responsibilities for initiating and directing the technical programs consistent with the mission of NBS. The initiation of technical programs with outside organizations such as NASA primarily occurs independently from within the major organizational units.

A.2.2 Science Goals and Objectives

NBS science utilization planning for the Space Station includes the disciplines of materials sciences, astrophysics, and "Other" (i.e., combustion/fire and electronics).

A.2.2.1 Materials Sciences

A number of materials sciences discipline areas will be researched. These include thermophysics, containerless processing, and the study of fluids asymptotically close to critical points.

Thermophysics - Selected thermophysical properties of high-temperature materials in their liquid state will be measured with an unprecedented accuracy over a previously unattained temperature range. Such measurements will expand our understanding of the behavior of substances at high temperatures and provide a means for testing the relevant theories and models describing the material properties. The NBS

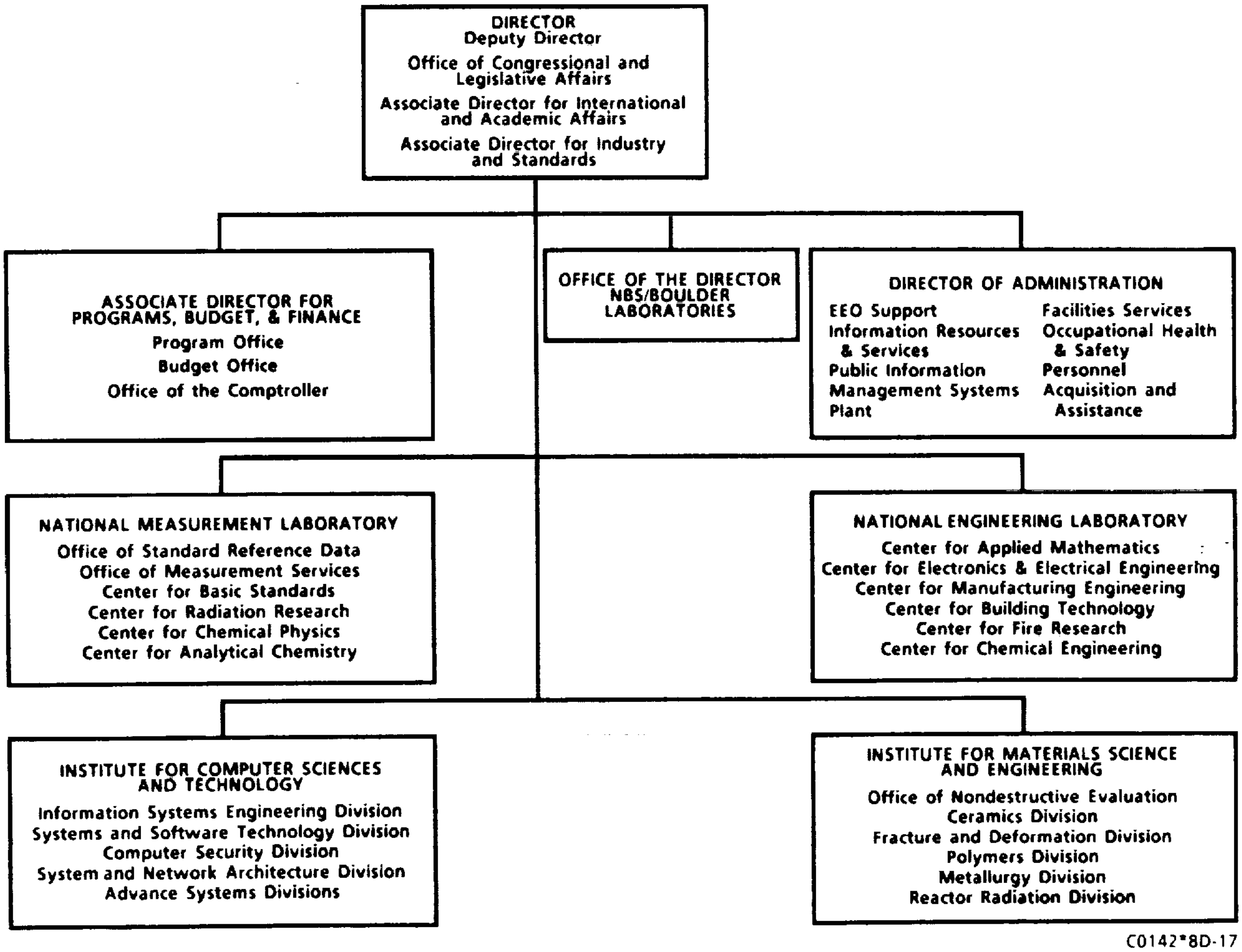

Figure A-2. NBS Management Structure

plans to develop techniques and prototype instrumentation for thermophysical measurements to be performed in the Space Station. One of the areas of instrumentation development is fast pyrometry for dynamic temperature measurements. This type of instrumentation is needed not only in the NBS experimental technique but represents a general-purpose capability that will be needed in various other experiments in the Materials Sciences.

Containerless Processing - The reduction of buoyancy-driven convection and sedimentation and the ability to process highly reactive materials containerlessly provides unique experimental opportunities in the microgravity environment of the Space Station. Various experiments in the area of alloy solidification will be carried out to test basic concepts relevant to earth-based processes and to measure selected thermophysical properties to greater accuracy than is possible in earth-based experiments. The investigations would be carried out in conjunction with NASA using equipment developed by or available to NASA (e.g., the directional solidification furnaces being developed by the Microgravity Science and Applications Division of NASA).

Fluid Critical Points - When pure fluids are studied near critical points on earth, the weight of the fluid induces a significant density stratification which limits the resolution of the best experiments. If other aspects of the experiment could be controlled sufficiently well, a microgravity environment would extend the resolution of the best experiments on pure fluids. One objective is to determine the behavior of thermodynamic and transport properties asymptotically close to critical points. The discipline is now quite mature in both experiment and theory; therefore, precisely defined quantitative measurements are of interest. The science requirements include: (1) low gravity for a long period (many days), (2) very tight temperature control, (3) low data rates, and (4) little interaction with a mission specialist. Free-fliers might be ideal if they could be cost-effective and meet the environment requirements. At present, several experiments are being developed for the Materials Sciences Laboratory for the Shuttle.

A.2.2.2 Astrophysics

A multi-instrument experiment incorporating the Simultaneous Multiwavelength Astrophysical Monitoring Experiment (SMAME) and a 30-meter imaging interferometer is discussed in detail in the following paragraphs.

SMAME - The objective of this experiment is to observe transient phenomena on active stars with high time resolution simultaneously in the X-ray, ultraviolet, and optical regions of the spectrum. The SMAME should include at least three simple instruments of small aperture that are coaligned and have modern, but not necessarily state-of-the-art, detectors. The instruments would consist of:

(1) An X-ray photometer experiment with a grazing-incidence telescope (perhaps of the Broad-Band X-ray Telescope (BBXRT) design) and an Imaging Proportional Counter (IPC) or Charge-Coupled Device (CCD) array detector;

(2) A small aperture (say 25 cm) normal-incidence telescope feeding a low-dispersion ultraviolet spectrograph with a CCD array detector; and

(3) A small aperture (say 10 cm) normal-incidence telescope feeding an optical photometer.

Imaging Interferometer - The concept for a 30-meter imaging interferometer loosely attached to the Space Station is based on the use of roughly 15-meter sections of graphite-epoxy truss structure to form the basic mechanical support system. One simple design is a Y-shaped array of 3 coplanar arms, each 15 meters long and 1.5 meters in diameter, together with a perpendicular mast of similar length. Roughly 15 observing telescopes of 0.5-meter diameter would be used, with laser interferometers controlling the optical pathlengths. The estimated total mass of the imaging interferometer is about 3,000 kg. With this design, the entire interferometer can be carried to orbit with a single Shuttle launch and then deployed.

A.2.2.3 Combustion/Fire

The Center for Fire Research at NBS plans to utilize the Space Station in one phase of a program to obtain specific information on the fire safety of the Station itself. The program elements are:

(1) Determination of the flammability characteristics of the materials of potential use for the Station, including ignition, flame spread, products analysis, and heat release rates;

(2) Conduct of a limited number of small-scale (1/10th) validation experiments based on likely fire scenarios to compare with predictions calculated using theoretical models with the above data input; and

(3) Conduct of experiments to understand soot formation mechanisms in flames without buoyancy-driven convective flow.

These experiments can be conducted using the planned combustion experiment facilities in the Space Station. The planned combustion diagnostic tools will be adequate for the measurement for the experiments. The 1/10th small-scale mock-up will be built in collaboration with NASA.

A.2.2.4 Electronics

The primary objective is the establishment of a comprehensive space power metrology/materials program to focus on:

(1) The effects of the space environment on advanced instrumentation systems, and

(2) The determination and characterization of the degradation mechanisms of electrical insulation and dielectric material in the space environment.

With the transition of electrical power technology from terrestrial utilization to space application, tests are needed to characterize the performance of advanced metrology systems in the space environment. While land-based requirements, practices, and test procedures for power system applications are reasonably well documented, they still require improvement resulting in research and development of these systems being conducted by a large number of laboratories. Even with this technical activity, few models exist which simulate the effects of low gravity, radiation, outgassing, etc., in such areas as systems design, component performance, and calibration strategies. In addition, the long-term effects of a hostile space environment on electrical insulation and dielectric materials are in the early stages of study, and a definitive data base on degradation mechanisms is necessary for the establishment of advanced concepts and materials for future applications. In this regard, the unique expertise of the NBS can be instrumental in designing test systems, methods, and procedures for materials, devices, and components developed by the space power community.

A.3 NATIONAL INSTITUTES OF HEALTH

A.3.1 Management Plans

The National Institutes of Health (NIH) space biomedical research program is largely in the early planning phase. The present organizational structure is shown in Figure A-3. Currently, the Office of Science Policy and Legislation, NIH, serves as the central focus for planning and coordinating NIH activities in this area of research, and it functions in providing liaison to NASA during program development. An advisory and coordinating apparatus is planned to assist in defining the future course of this program and to assist in developing a more refined and cohesive program structure.

A.3.2 Science Goals and Objectives

The primary objectives of NIH activities in the life sciences will be:

(1) To utilize the unique microgravity environment that will exist in the Space Station's pressurized laboratories and the availability of the crew, operators, and subjects to develop new knowledge leading to the solution of a broad spectrum of conventional health problems that exist on earth; and

(2) To study the health effects of prolonged space flight toward the goal of safeguarding and protecting the health of space travelers.

The variety of facility-class systems located in the pressurized modules of the Space Station will be used to accomplish initial program objectives. Additional facilities and specialized instrumentation will be identified and developed in response to demands of the user scientific community. Specific research projects will be selected through a peer review process.

A.4 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

A.4.1 Management Plans

The National Oceanic and Atmospheric Administration's (NOAA's) planning and coordinating activities for Space Station utilization are

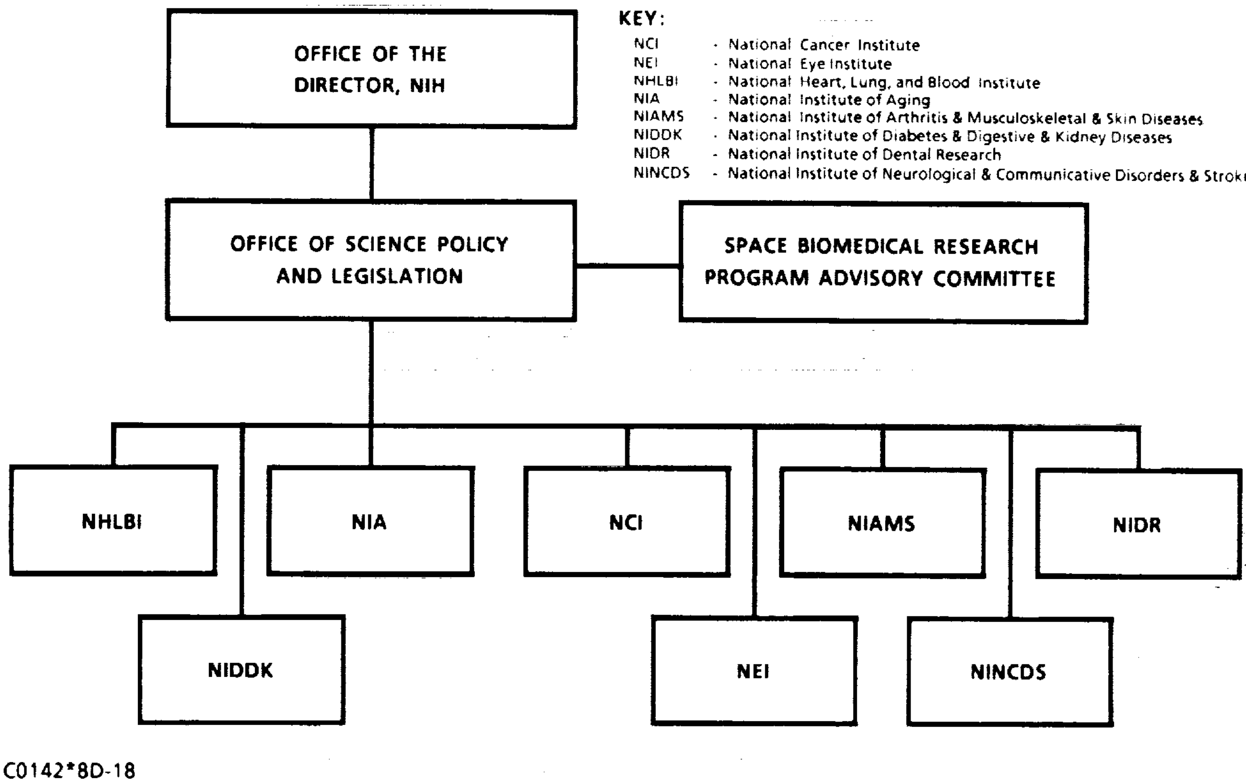

Figure A-3. NIH Management Structure

focused within its National Environmental Satellite, Data, and Information Service (NESDIS). The NOAA organizational structure is shown in Figure A-4.

A.4.2 Science Goals and Objectives

NOAA's interest in the Space Station activity is to address agency missions in measurements related to the biosphere, hydrosphere, atmosphere, cryosphere, lithosphere, as well as space physics. NOAA is proposing that the first NASA platform and the ESA platform be made available for operational use. Ideally, the deployment of the polar platform should dovetail with the end-of-life of the last NOAA series of polar orbiting satellites (the NOAA-K, -L, and -M series). The purpose of

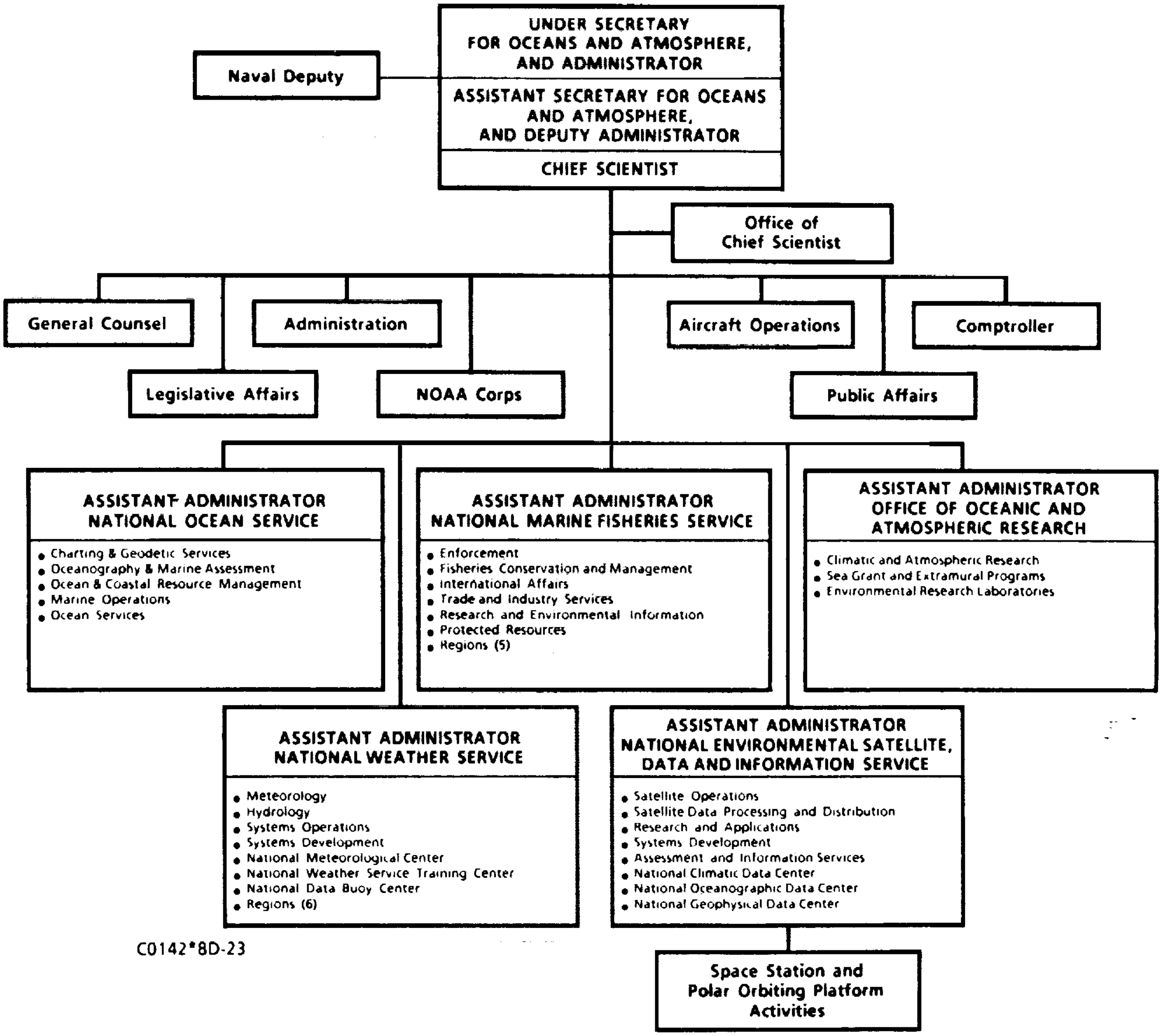

Figure A-4. NOAA Management Structure

these NOAA satellites is primarily related to weather and atmospheric sciences.

NOAA's interests in the disciplines of Earth Sciences, Space Physics, and Communications are exemplified by the specific research missions discussed in detail in the following paragraphs.

A.4.2.1 Earth Sciences

This discipline is supported by six specific research missions.

(1) Advanced Medium Resolution Imaging Radiometer (AMRIR) - Its basic purpose is to scan the earth, measuring the radiation in 11 spectral bands.

(2) Advanced Microwave Sounding Unit (AMSU) - AMSU is a 2-part passive microwave radiometer comprised of 20 channels for accurate atmospheric soundings. Accommodation studies will be made to adapt the units to the platform configuration.

(3) Data Collection and Location System (ARGOS) - The ARGOS collects environmental data from in-situ data collection platforms (DCP's) (i.e., wildlife, balloons, ice, buoys, etc.), relaying these data and/or derived parameters to a ground station.

(4) Earth Radiation Budget Instrument (ERBI) - the ERBI system will measure the earth radiation budget (ERB) parameter. It is planned for the polar platform and is similar to the ERBI instrument onboard NOAA-9 and -10.

(5) Global Ozone Monitoring Radiometer (GOMR) - GOMR will be measuring total ozone and the vertical distributions of ozone, other trace gases, and temperature at altitudes above the tropopause. GOMR is planned for flight on the polar platform.

(6) Scatterometer (SCATT) - the SCATT will collect detailed data on user-surface ocean winds. Its design is based on the scatterometer that flew on SEASAT and is proposed for flight on the polar platform.

A.4.2.2 Space Physics

Space Physics research will be supported by the Space Environment Monitor (SEM) package. This package is an augmented version of previous SEM's. It consists of five unique instruments designed to measure energetic particles, protons, electrons, local electric field, magnetic fields, and radio wave propagation.

A.4.2.3 Communications

The Search and Rescue Satellite (SARSAT) system has evolved from studies conducted by NASA to define a cost-effective, satellite-aided, search and rescue system capable of monitoring distress transmissions from Emergency Location Transponders (ELT's) and Emergency Position Indicating Radio Beacons (EPIRB's). NOAA's Search and Rescue (S&R) system is capable of monitoring and locating distress transmissions from aircraft, marine, and other transponders and relaying this information to rescue personnel. The system will become operational with the launch of the NOAA-K, -L, and -M series and will be carried over to the polar platform. The electronics package making up the S&R system on the platform is provided to NOAA under a joint program by Canada and France.

A.5 NATIONAL SCIENCE FOUNDATION

A.5.1 Management Plans

The Foundation does not expect to develop independent plans for use of the Space Station but does expect to participate in the OSSA planning process through representation on Advisory Groups and interagency management bodies and through multiple linkages and consultations between NSF and NASA staffs within the individual disciplines. Although the disciplinary structure at NSF does not track closely with that at NASA, the organization chart in Figure A-5 provides an indication of the appropriate cross-links that need to be maintained.

The National Science Foundation is organized in Directorates, each having a very broad range of disciplinary and programmatic responsibility. The Foundation is tasked with the support of basic research across most areas of science and engineering, with the exception of disease-related biomedical research. Nearly all of the Foundation-funded research is carried out by colleges and universities, and the Foundation has a special interest in ensuring that Space Station planning provides ample opportunities for research by university investigators (whether funded by NASA or by NSF) and in all disciplines whether or not they fall within the range of those normally emphasized by NASA. Principal Investigators for NSF-funded research are chosen competitively on the basis of unsolicited proposals submitted in response to general or more specific program announcements.

Level I (policy) interfaces with NASA will be at the level of the Director's Office (or an Assistant Director where a specific disciplinary

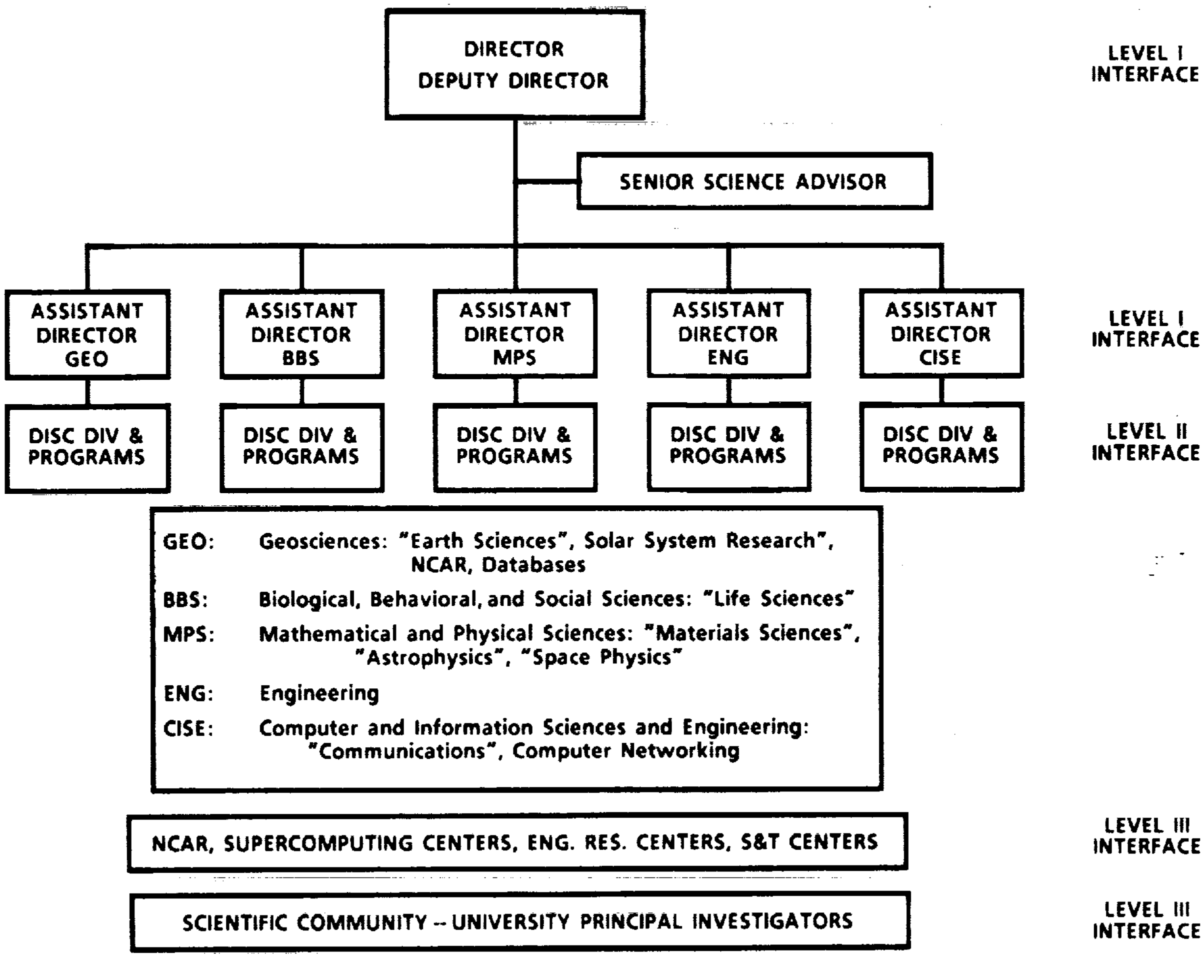

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Figure A-5. NSF Management Structure

area is concerned). Level II (disciplinary) interface will be through Assistant Directors, Division Directors, or Program Officers within the Foundation's disciplinary structure. Level III (field- or operating-level) interfaces will be with researchers or managers at universities or at NSF-funded facilities such as the National Center for Atmospheric Research (NCAR) or the Supercomputing Centers.

A.5.2 Science Goals and Objectives

NSF's objectives cover the entire range of science disciplines identified with Space Station utilization. A brief description of NSF's planned research in these areas follows.

A.5.2.1 Life Sciences

The Space Station provides opportunities for studying the growth, reproduction, and functioning of biological systems and life processes in a microgravity environment and the opportunity to observe the distribution and changes of ecosystems on the earth from space. NSF's Directorate for Biological, Behavioral, and Social Sciences (BBS) supports basic research by university investigators on a wide range of topics in these fields. There are currently no long-range plans for development of specific flight instruments.

A.5.2.2 Materials Sciences

The opportunity to conduct materials-related experiments in a microgravity and/or high-vacuum environment is of special interest. Materials Sciences research is supported through the Directorate for Mathematical and Physical Sciences (MPS). Objectives are to advance the fundamental understanding of the interrelationships among synthesis/processing, structure, properties, and performance of materials at macroscopic, microscopic, and molecular levels and to facilitate the transfer of knowledge into technology through the education and training of future industrial scientists and engineers. Instrumentation for a wide variety of materials-processing techniques (including high-temperature techniques) in the microgravity and/or high-vacuum environment would be a high priority.

A.5.2.3 Astrophysics

Space Station is of interest as an observing platform less-subject to terrestrial interferences than ground sites. Astrophysics research is supported by the Directorate for Mathematical and Physical

Sciences (MPS) with the objective of increasing our understanding of the physical nature of the universe: the solar system, the sun, and individual stars, star clusters, the Milky Way and other galaxies, special objects such as molecular clouds and quasars, the large-scale structure of the universe itself, and the physical laws that govern its behavior. There are currently no long-range plans for development of specific flight instruments, but requests to use NASA instruments and to share data are likely.

A.5.2.4 Earth Sciences

Space Station (and especially the EOS) is an attractive platform from which to observe the earth. The NSF Directorate for Geosciences (GEO) supports research in all areas of the atmospheric, earth, and ocean sciences as well as in multidisciplinary areas such as Earth System Science, Global Geosciences, or Global Change. This Directorate also has special responsibility for conduct and management of all research carried out in the polar regions, especially the Antarctic. NSF is unlikely to develop its own flight instrumentation, but PI interest in use of NASA instrumentation and sharing of earth observational data is likely to be high. The NSF-funded National Center for Atmospheric Research (NCAR) plays a major role in archiving and disseminating earth observational data and in computer modeling of global systems.

A.5.2.5 Space Physics

Activities that might be classified as Space Physics are supported by both the Directorate for Mathematical and Physical Sciences (MPS) and by GEO. The range of activities is very wide and covers the fields of astronomy; astrophysics; cosmology; theoretical physics; gravitation; particle physics; atomic, molecular, and plasma physics; aeronomy; and solar-terrestrial studies.

A.5.2.6 Solar System Research

Aeronomy and solar-terrestrial research are supported by the Division of Atmospheric Sciences within GEO. Research on the sun and objects within the solar system is supported by the Division of

Astronomical Sciences within MPS. Research on meteorites and planetary materials is supported by the Division of Earth Sciences within GEO and collection of meteorites and extraterrestrial materials from the polar regions by the Division of Polar Programs, also in GEO. NSF supports a number of ground-based facilities used for Solar System Research.

A.5.2.7 Communications

The Space Station offers a unique opportunity for experimental investigation of the effects of high-delay links in a computer network. Of particular interest are studies of the extent to which time-critical applications aboard the Station can accommodate the variable latency of mixed-use packet-switching networks and thereby release scarce, dedicated bandwidth for other uses.

A.6 NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

A.6.1 Management Plans

Detailed plans for involvement of the National Telecommunications and Information Administration's (NTIA's) Institute for Telecommunication Sciences (ITS) in the Space Station science program have not yet been finalized and will depend on available resources. The NTIA organization chart is shown in Figure A-6.

A.6.2 Science Goals and Objectives

The NTIA anticipates contributing to Communications research in two ways: first, by conducting experiments and demonstrations to implement and optimize advanced communication technologies relevant to space communications; and second, by assisting other Space Station science users in efficiently meeting their data, voice, and video communications needs. Work in the first area would build on NTIA's current involvement in NASA's Advanced Communications Technology Satellite (ACTS) program. Work in the second area would utilize NTIA's experience in network planning and telecommunication standards development. It is possible that ITS could also contribute to the development, integration, and evaluation of the Space Station Information System.

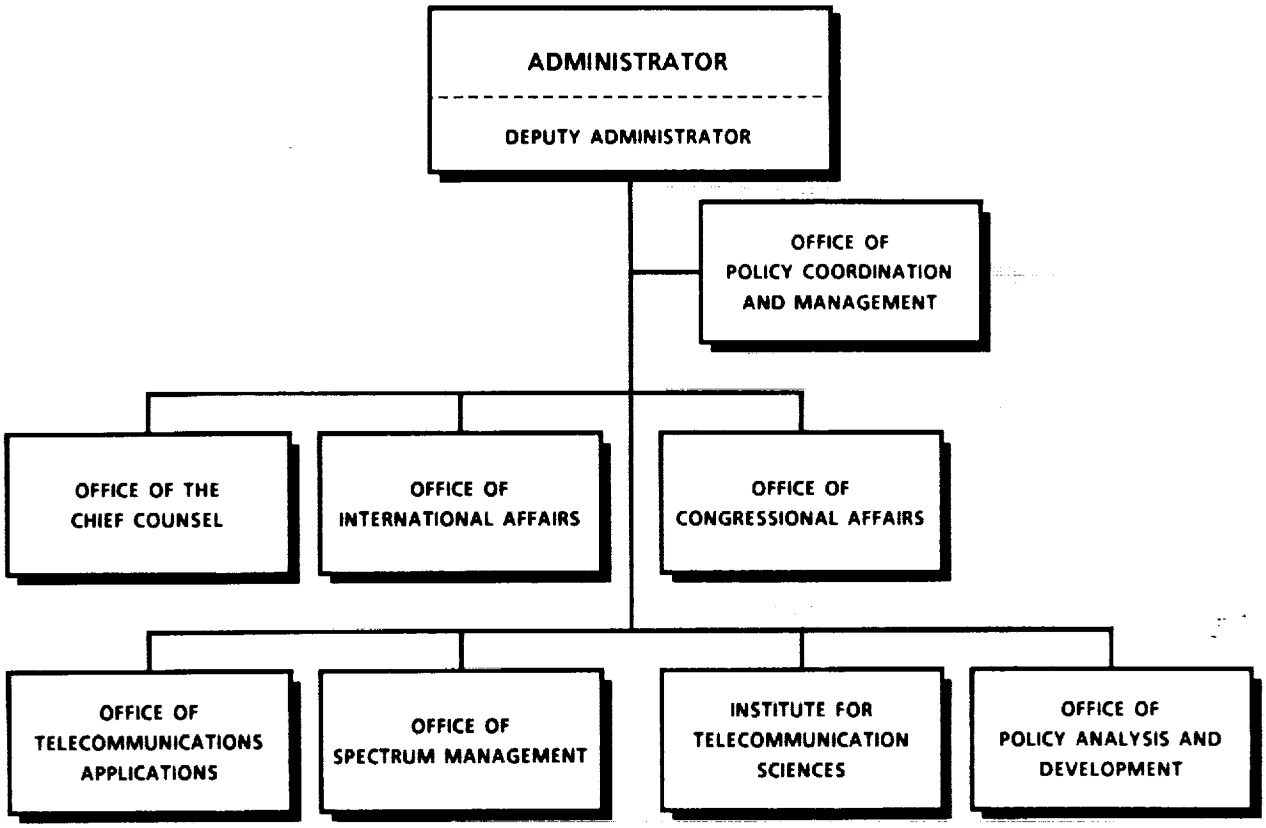

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Figure A-6. NTIA Management Structure

A.7 UNITED STATES DEPARTMENT OF AGRICULTURE

A.7.1 Management Plans

Within the United States Department of Agriculture (USDA), the areas of Science and Education, Natural Resources and Environment, and Economics are interested in participating in Space Station-hosted research activities (as shown in Figure A-7). Individual scientists and working groups will coordinate the activities of the various science disciplines in the five separate services listed on the chart. The Agricultural Research Service represents USDA in-house research activities versus the Cooperative State Research Service which is funded directly through universities or the Agricultural Experiment Stations at the Land Grant schools. They have interests in Life Sciences, Earth Observation, and Materials Processing.

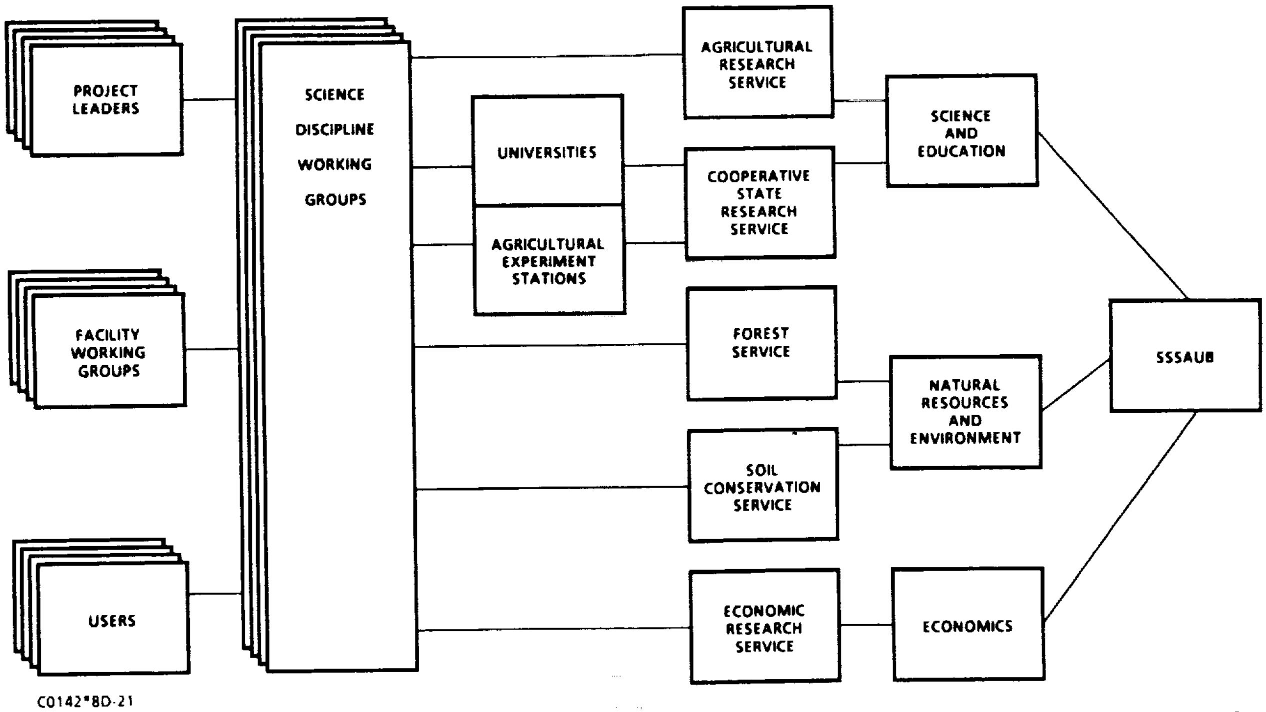

Figure A-7. USDA Management Structure

The Forest Service, Soil Conservation Service, and Economic Research Service are primarily interested in Earth Observation activities. Discrete discipline areas will be identified, and scientists within those disciplines will interact to develop obtainable goals by which USDA scientists can interact with their colleagues from other areas to maximize Space Station scientific output.

A.7.2 Science Goals and Objectives

USDA's objectives, associated with Space Station utilization, cover the fields of Life Sciences, Materials Processing, and Earth Sciences.

A.7.2.1 Life Sciences

The microgravity environment of Space Station provides research opportunities to:

(1) Understand how gravity affects plant and animal growth and production efficiency, and

(2) Enhance our ability to control biological microgravity life support systems that will provide oxygen and edible foods.

Biotechnology research would help in the design development of new plant and animal species designed for microgravity, a Space Station environment, or ultimately for lunar bases and beyond. USDA plans the shared use of NASA plant and animal habitats, variable-gravity centrifuges (both 1.8-meter and 4.0-meter or larger), and equipment such as imaging analysis, freezers, refrigerators, laboratory centrifuges, tissue preparation, dissection, and preservation. Scientists in both animal and plant disciplines will be involved.

A.7.2.2 Materials Processing

USDA is currently developing biodegradable packaging materials which could be of some benefit on Space Station for use in CELSS by adding to the biomes for plant and animal growth. Later, such materials could facilitate the delivery of carbon and hydrogen to lunar bases. Biodegradable materials could also simplify trash handling.

This research is being actively pursued at this time. The developing technology may facilitate Space Station and lunar base operations. Additional types of packaging materials, which are primarily modified starch, could be developed if there seemed to be a benefit for microgravity use.

A.7.2.3 Earth Sciences

Earth observation will enhance abilities to predict crop production, precipitation, water storage, drought, plant disease, and forest and range fires. Increases and decreases in the area of productivity of crop, range, savannah, and desert biomes is important in charting United States and world food production and to be able to ultimately predict seasonal changes for both short-term (annual) effects and for a longer-term basis which may reflect other cyclic manifestations or long-term changes in the earth's biosphere.

USDA will not require, for the most part, pressurized modules but will have earth-observation requirements for polar and other platforms associated with Space Station. Most observations will utilize equipment already planned for Space Station use. Coordination and cooperation in the use of this equipment with NOAA, NASA, and perhaps USGS and NSF will facilitate overall science return.

A.8 UNITED STATES GEOLOGICAL SURVEY

A.8.1 Management Plans

Remote sensing activities of the United States Geological Survey (USGS) are coordinated through a Committee chaired by the Office of the Assistant Director for Research. The same office performs coordination functions with NASA Code E and Space Station Management and Advisory committees. The Earth Resources Observing System (EROS) Data Center in Sioux Falls, SD will serve as the terrestrial data archive for EOS data; the Data Center resides in the National Mapping Division. The USGS organization is depicted in Figure A-8.

A.8.2 Science Goals and Objectives

The USGS's primary interest lies in the Earth Sciences. The Space Station and platforms would be utilized for the remote sensing of configuration and materials of the earth's surface, including water, ice, biota, and cultural features; coordinated ground and space observation of terrestrial and coastal processes; observation of gravity and magnetic fields of the earth; and measurement of geodynamic processes. The USGS anticipates sharing NASA instrumentation and possibly developing specialized instrumentation for mapping.

A.9 DEPARTMENT OF ENERGY

A.9.1 Management Plans

The Department of Energy (DOE) will work closely with NASA and participate in Space Station utilization planning through representation on

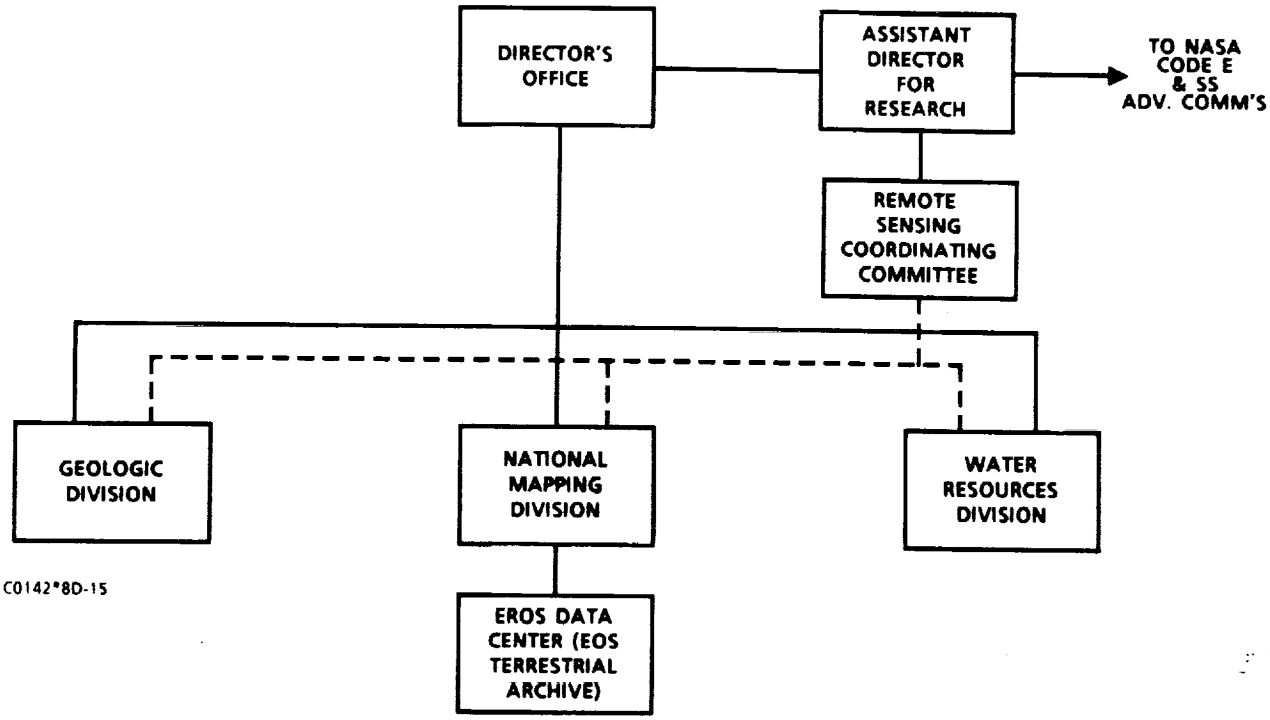

Figure A-8. USGS Management Structure

advisory groups through interagency bodies, and through discussions and consultation between DOE and NASA staffs. Space Station utilization activities within DOE will be managed by the Office of Energy Research (OER). The OER management structure is presented in Figure A-9. The Carbon Dioxide Research Division of the Office of Basic Energy Sciences will act as a representative to the advisory groups and for overall coordination within DOE for Space Station utilization.

A.9.2 Science Goals and Objectivies

DOE's goals and objectives are to ensure energy for continued economic development and security of the United States. Accordingly, it supports research activities in the Life Sciences, Atmospheric Sciences, Earth Sciences (including the Geosciences), and Materials Sciences. Space Station utilization is expected to include Earth Sciences and Materials Sciences research.

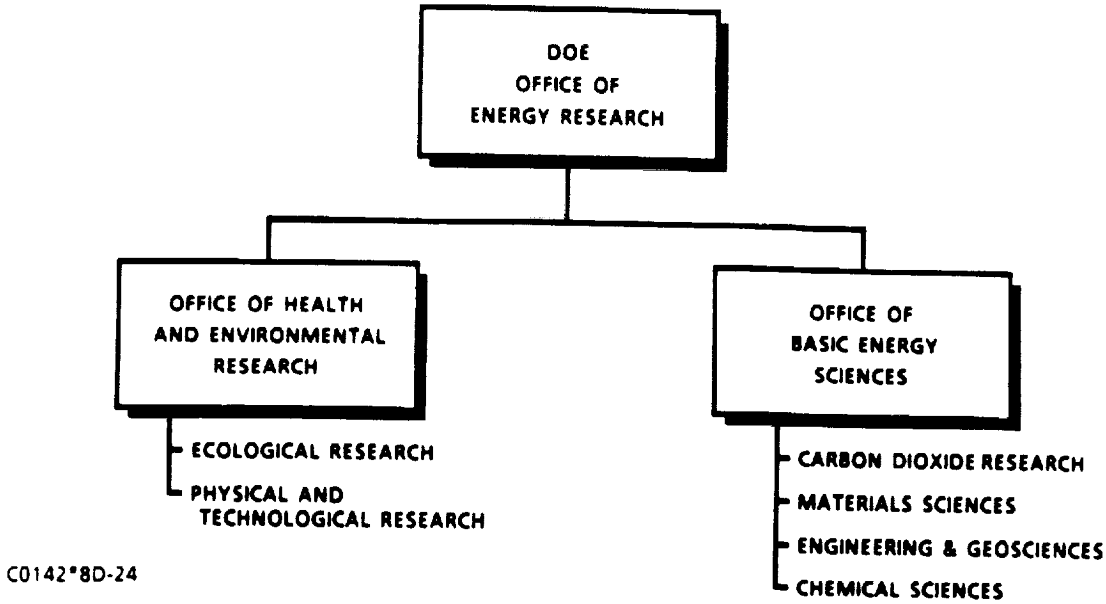

Figure A-9. OER Management Structure

A.9.2.1 Earth Sciences

Within the earth sciences and the hydrology area, responses of terrestrial ecosystems to energy-related disturbances, analysis related to waste disposal, and regional research related to global change are examples of near- and long-term benefits to the DOE from Space Station utilization. Primary areas of interest will include the use of EOS sensors for investigation of terrestrial productivity and vegetation structure. Space Station-based remote sensing data (which will be obtained dealing with the biosphere, oceans, and the atmosphere) will play a vital role in developing an improved understanding of climate systems, and improved climate and carbon cycle models. Geoscience data will aid in energy exploration.

A.9.2.2 Materials Sciences

Materials-related experiences in microgravity and/or high vacuum environments are also of interest to DOE.

APPENDIX B

U.S. SPACE STATION SCIENCE AND APPLICATIONS USER BOARD (SSSAUB) CHARTER

APPENDIX B

U.S. SPACE STATION SCIENCE AND APPLICATIONS USER BOARD (SSSAUB) CHARTER

The purpose of the Space Station Science and Applications User Board (SSSAUB) is to serve as the principal coordination and planning body at the strategic level among the U.S. Government agencies intending to use the Space Station for scientific purposes. In order to carry out this function, the SSSAUB will review and coordinate agency plans for utilizing the Space Station, will integrate these plans as appropriate, will recommend prioritization of Station resources among user disciplines over a 5-year strategic planning period, will provide a forum for the exchange of scientific information relating to the program, and will serve an advocacy role for the scientific utilization of the Space Station.

Each individual agency will continue to be responsible for the development of its own goals and Space Station utilization plans. The SSSAUB will not be responsible for the approval of such goals and plans nor will it become involved with detailed discipline program planning.

The principal product of the SSSAUB will be a consolidated 5-year U.S. science and applications plan for use of the Space Station Program, including top-level operations requirements, resource allocations, and integration strategies. This plan will be updated annually.

The results of the SSSAUB's annual strategic planning process will be forwarded through the Chairman to the U.S. Space Station User Board (SSUB) for integration with the plans of other Space Station users. This will result in a consolidated U.S. strategic plan for the use of the Space Station, which then will be coordinated with the plans of the other Space Station International Partners.

To ensure that strategic planning considers the actual results of ongoing utilization activities, the SSSAUB will maintain top-level oversight of the tactical, increment, and execution phases of the Space Station science operations process. The Office of Space Science and Applications (OSSA) will be responsible for preparing regular status summaries of ongoing utilization activities for the SSSAUB.

Membership in the SSSAUB is initially established as being one representative each from OSSA, the National Bureau of Standards, the National Institutes of Health, the National Oceanic and Atmospheric Administration, the National Science Foundation, the National Telecommunications and Information Administration, the U.S. Department of Agriculture, the U.S. Department of Energy, the U.S. Geological Survey, and other federal agencies as appropriate. The Associate Administrator of NASA's OSSA will serve as the Chairman of the SSSAUB. The SSSAUB may establish working groups, as required.

The SSSAUB will meet approximately one-to-two times per year to carry out its mandate. Scheduled meetings will be on the call of the Chairman. Additional meetings will be held if requested by two or more members. Technical and administrative support to the SSSAUB will be provided by OSSA as required.

SSSAUB decisions and recommendations, to be forwarded to the SSUB in the name of the SSSAUB, normally will be adopted by consensus. If a consensus cannot be achieved, the Chairman will have final resolution authority within the Board. If instances of dispute arise, Board members can take the issue to the appropriate agency administrators for resolution.

An independent oversight group will be established to monitor and evaluate the performance of the SSSAUB in providing fair and reasonable levels of participation by all member agencies and in advocating provisions for strong federally sponsored research on the Space Station.

This Charter will be adopted upon approval of the Space Station Science and Applications Utilization Plan by the initial member agencies. Thereafter, amendments can be made by consensus of the members. Any such amendment will be signed by all the members at the Associate Administrator level and attached to this Charter.

APPENDIX C

LETTER OF AGREEMENT BETWEEN
THE OFFICE OF SPACE STATION AND
THE OFFICE OF SPACE SCIENCE AND APPLICATIONS

(Note: Formal approval of this Letter of Agreement is expected in the near future.)

APPENDIX C

LETTER OF AGREEMENT BETWEEN
THE OFFICE OF SPACE STATION AND
THE OFFICE OF SPACE SCIENCE AND APPLICATIONS

C-I. PURPOSE

The Office of Space Station (OSS) and the Office of Space Science and Applications (OSSA) are mutually committed to full and effective cooperation in the development and use of the Space Station as a national resource for the conduct of research and development activities in the space science and applications disciplines. The purpose of this agreement is to delineate the obligations and responsibilities of the OSS and OSSA with respect to each other and to establish the framework for future working relationships during the design, development, verification, and operations phases of the Space Station Program.

C-II. ROLES AND RESPONSIBILITIES

A. General

OSSA is responsible for overall planning, selection, direction, execution, and evaluation of NASA programs concerned with space science and applications. OSS is responsible for overall planning for, and management of, the development, effective utilization, and operations of the initial and evolutionary Space Station.

B. Intersections

1. External Interfaces

OSS serves as the principal Agency focal point and interface with U.S. and international communities on Space Station Program (SSP) matters. OSSA serves as the principal Agency focal point and interface with U.S. space science and applications communities on matters of utilization of the Space Station and with international space science and applications communities on collaborative and cooperative research and development activities on the Space Station.

2. SSP Interfaces

OSS and OSSA will establish both formal and informal interfaces at all appropriate levels of their organizations to coordinate plans and activities on all aspects of the Program which relate to full and effective use of the Space Station by the space science and applications communities.

The interface for all official OSSA Level I user requirements and utilization planning shall be between the Assistant Associate Administrator for Space Station, OSSA, and the Director, Utilization Division, OSS.

The formal interface for all Level II utilization and operations issues and requirements will be between the Director, Flight Systems Division, OSSA (as chairman of the OSSA Level II Space Station Control Board), and the Director, Program Utilization and Operations Group, Space Station Program Office (SSPO). The Director, Flight Systems Division, will be responsible for appropriate interfacing with other OSSA divisions, especially the Communications and Information Systems Division, with regard to these "controlled" issues.

3. Configuration Control Boards

The SSP shall establish and manage configuration control boards (CCB's) at all appropriate levels to control Space Station hardware, software, and interface requirements and design. OSSA shall appoint representatives to support and participate in Configuration Control Boards (CCB's) whose activities affect OSSA payload or systems utilization, development, and operations.

4. Panels and Working Groups

OSSA shall provide representation on OSS working groups and panels where OSSA interests are involved. OSS shall provide representation on OSSA working groups and panels whose work affects OSSA Space Station utilization.

5. Mission Planning

OSSA will conduct detailed analysis of candidate OSSA missions leading to operational scenarios and validated mission resource and system requirements. OSS will integrate these results with inputs from other user communities, will conduct mission analyses and accommodation studies, and will develop system architecture, configuration, and subsystem designs to obtain a detailed description of the Space Station and its user interfaces. OSSA will review these results in terms of their fidelity to OSSA mission requirements.

6. Mission Requirements

OSSA will define mission requirements, including logistics and servicing requirements, for the design, development, test, evaluation, integration, and operation of OSSA payloads in or on the Space Station. OSS will conduct analyses related to manifesting, transportation, installation, and functional integration of specified OSSA payloads to the Space Station. OSSA will support these analyses in terms of OSSA mission priorities and payload relationships.

7. Mission Operations

OSSA will provide for operation of its payloads on Space Station elements within constraints agreed upon between OSSA and the SSP. The SSP will operate the Space Station and will incorporate OSSA payload operations in its overall Station operations. OSSA will provide for operation of Space Station platforms on which its missions are the predominant payload, except during initial on-orbit checkout and during periods of operation in proximity to the Shuttle or Space Station Manned Base.

8. Space Medicine/Operational Medicine

OSSA shall be responsible for the planning and implementation of all ground and space research activities aimed at developing requirements or procedures to ensure space crews' health and performance. Planning, coordination, and implementation of the operational medicine program in support of OSS on-orbit operations will be performed by OSSA. OSS and OSSA are mutually responsible for coordinating these plans and activities, utilizing the existing operational medicine infrastructure within the Life Sciences Division, OSSA.

9. Space Facilities

OSS is responsible for providing the Laboratory Support Equipment and the General Laboratory User Support Equipment, as specified in the Program Definition and Requirements Document (PDRD) or other applicable document, for use in the Space Station pressurized modules. OSSA is responsible for development of requirements for this equipment, for participating in the development process of this equipment, and for the design and development of experiment-specific equipment.

10. Ground Facilities

OSS will recognize and support specific OSSA requirements in the design and development of Space Station ground facilities and logistics systems. OSSA will support this work, particularly with respect to information system interfaces and facility outfitting.

C-III. MUTUAL CONSIDERATIONS

OSSA and OSS agree to meet regularly, at appropriate levels, to discuss, review, and coordinate Space Station-related activities. OSSA and OSS agree to consider joint funding and management of tasks in which both parties have vested interests. OSSA and OSS agree to coordinate planning and development schedules related to their mutual interests in the Space Station. OSSA and OSS agree to work together to ensure high proficiency of space and ground crews in effecting productive scientific utilization of all Space Station elements.

C-IV. DURATION OF AGREEMENT

This agreement shall be reviewed annually and, if necessary, modified with the consent of both parties. It shall remain in effect during the design, development, and verification phases of the Space Station Program.

C-V. OTHER MOUs/MOAs

This Letter of Agreement does not limit or preclude exisiting or future agreements between OSS and OSSA in specific areas of mutual interest.

Signatures: ______________________________

Associate Administrator, Office of Space Station

____

Associate Administrator, Office of Space Science and Applications

Approval: ______________________________

Deputy Administrator

APPENDIX D

SPACE STATION INFORMATION SYSTEM
MEMORANDUM OF UNDERSTANDING

BETWEEN

OFFICE OF SPACE STATION
OFFICE OF SPACE SCIENCE AND APPLICATIONS
OFFICE OF SPACE OPERATIONS

March 18, 1988

SPACE STATION INFORMATION SYSTEM MEMORANDUM OF UNDERSTANDING

I. PURPOSE AND SCOPE

This memorandum of understanding constitutes the top level agreement between the three principal NASA Offices involved in the definition, development, operation, and subsequent evolution of the Space Station Information System (SSIS). It outlines the concept of the end-to-end, integrated SSIS and, based upon this concept, defines roles, responsibilities, and the mechanisms for coordination, integration, and oversight.

II. CONCEPT OF THE SPACE STATION INFORMATION SYSTEM

The Space Station Information System is that combination of hardware, software, interconnections, and people that enable the interaction between Space Station users, their associated Space Station payload elements, and the Space Station systems to take place in a coordinated, efficient, and productive manner. The SSIS provides for the interactive monitor and control of the user payloads, elements, and systems and for the collection, transmission, processing, storage, and exchange of data among Space Station ground-based systems and users. At any given time, the ground systems and users may be interacting with one another or with the in-orbit systems from widely distributed locations.

III. ORGANIZATIONAL RESPONSIBILITIES

This section delineates the overall responsibilities of the Office of Space Station (OSS), the Office of Space Science and Applications (OSSA), and the Office of Space Operations (OSO) for the Space Station Information System. These responsibilities generally fall within the established charters of these organizations and are provided here and in the Appendices for information and clarification. Each Program Office has the total responsibility for executing its elements of the Space Station Information System.

In formulating this Memorandum of Understanding, OSS, OSSA, and OSO agree to the following:

- The goal of the SSIS is to meet Space Station user requirements for timely, effective, and complete data and communication services.

- A major objective is to maximize the compatibility of OSS, OSSA, and OSO data and information systems to improve the efficiency and quality of NASA services to its various user communities, and to reduce overall systems development and operations costs.

- That to achieve compatibility objectives, we will utilize to the maximum extent possible, common internationally recognized standards for data and communication services.

- That a necessary element in the development of compatible OSS, OSSA, and OSO data and information systems is an integrated test bed program that involves the active participation of user organizations and the International Partners.

- That successful achievement of the above objectives will require a high degree of participation and cooperation between our organizations.

Responsibilities of each Program Office and involved institutional organizations encompass management, funding, strategic and tactical planning, definition, development, system engineering, configuration management, resource allocation, operations, and maintenance activities for their respective SSIS elements.

Office of Space Station (OSS)

The OSS is responsible for the system level requirements development, definition of system interfaces, documentation of the system architecture, and system level integration for the resultant Space Station Information System. The OSS also is responsible for the protection of the flight elements and the safety of the crew. The OSS is responsible for portions of the on-board Space Station Information System, the ground-located control center for the manned flight element, and certain other support capabilities as delineated in the Appendix.

Office of Space Science and Applications (OSSA)

The OSSA is responsible for all OSSA user unique services to include level-1* and higher level data processing; data distribution to the end users; archival of the space science and applications data in compliance with all applicable laws, rules, and agreements which pertain to data storage and access; instrument control centers; on-board user accommodation systems beyond those provided by OSS; and payload planning and operations within the safety constraints determined by the OSS. OSSA is also responsible for levying requirements on the OSS to ensure that the Space Station Information System architecture serves the needs of OSSA Space Station Program users and also for levying

* See attachment 1 for definitions of level 0 and higher levels of data processing.

requirements on the OSO to ensure that appropriate data handling and communications capabilities are provided. In addition, consistent with its role as mission manager for the NASA Space Station Program Polar Platforms, OSSA is responsible for coordination with the national and international space science and applications user communities for the integration of requirements and the coordination of user operations and other activities. Other OSSA responsibilities are delineated in the Appendix.

Office of Space Operations (OSO)

The OSO is responsible for providing those portions of the SSIS from the radio frequency interface at the flight elements through delivery of data to the various user facilities including carrier services for unique communications capabilities, flight dynamics operations and computational support at GSFC, certain operations centers, and level zero processing of user data up to an average aggregate rate of 20 Mbps. For the most part, this is a multi-user infrastructure which supports all NASA programs. Major elements are the Tracking and Data Relay Satellite System, communications networks, data distribution facilities, ground data collection facilities, the Platform Control Center, and data processing in accordance with agreed requirements. OSO also is responsible for the coordination with the International Partners for the tracking and data systems to be developed and/or operated during the Space Station era.

Other OSO responsibilities are delineated on the Appendix.

IV. COORDINATION, INTEGRATION, AND OVERSIGHT MECHANISMS

As stated in Section III, each Office has the responsibility for executing its programs. However, in the case of the Space Station Information System (SSIS) elements, it is essential that the activities of each organization be very closely coordinated. This section, with the associated Figure 1, describes the structure and mechanisms for accomplishing this coordination and integration. It is recognized that each organization may manage its programs differently with respect to delegation of responsibility, configuration management, etc. These internal processes and structures will not be a subject of this Memorandum of Understanding (MOU). In general, the process covered by this MOU defines how development of the SSIS system-level requirements, commitments, architecture, and major interfaces are to be coordinated between Program Offices for the Space Station Information System (SSIS).

Documentation

The formal part of the process involves a requirements and response documentation system. Two approved systems (NASA Management Instructions 8610.10 and 8610.10A for the National Space Transportation System and NASA Management Instruction 8430.1B for unmanned flight) exist within NASA for this purpose. It is expected that the Office of Space Station, the Office of Space Science and Applications, and the Office of Space Operations will use one of these systems or a combination of the two. The system to be used requires the approval of the three Offices involved.

Level 1 - SSIS Review Group

Responsibility for appropriate SSIS interface policy development, coordination of SSIS budget content, and periodic oversight of the SSIS development status is assigned to the Space Station Information System (SSIS) Review Group. The SSIS Review Group consists of the Deputy Associate Administrators for the Office of Space Station and the Office of Space Operations and the Assistant Associate Administrator for the Office of Space Science and Applications. The SSIS Review Group serves as the forum for presentation of issues identified by the SSIS Technical Integration Panel. In some cases, resolution of issues will be brought to the attention of the respective Associate Administrators. Resolution of issues with international implications is governed by the process delineated in the appropriate international agreements.

Level II - Space Station Information System Technical Integration Panel (SSIS TIP)

The primary responsibilities of the SSIS TIP are the coordination and integration of the SSIS system-level requirements, commitments, architecture, and major interface specifications, and assurance of the end-to-end functionality of the resulting delivered system. In this capacity, the SSIS TIP has delegated authority from the respective Associate Administrators and the Space Station Program Director.

The SSIS TIP is chaired by the Director of the SSIS Development Division of the Information Systems Services Program Group. It is composed of designated technical and programmatic representatives from Level-II, each Space Station Work Package Center, the Kennedy Space Center Ground Data Management System project, Goddard Space Flight Center Code 500 (representing OSO level II), designated OSSA representatives, and the International Partners (ESA, Canada, Japan). The SSIS TIP has direct support from the Space Station Program Support Contractor. Working groups may be established by the SSIS TIP to address specific technical issues.

The technical consensus reached by the SSIS TIP is forwarded for baselining to the respective management and control processes of OSS, OSSA, and OSO as appropriate (see Figure 1). Issues are forwarded to the SSIS Review Group for resolution when the SSIS TIP cannot reach satisfactory agreement.

V. EFFECTIVITY AND TERMINATION

This memorandum is effective when signed by the Associate Administrators for the Office of Space Station, the Office of Space Science and Applications, and the Office of Space Operations. It supersedes all previous agreements pertaining to the SSIS or its predecessor concepts. The memorandum may be modified at any time on the concurrence of the undersigned.

Associate Administrator
Space Station

Date 3/18/88

Associate Administrator
Space Science and Applications

Date 3/18/88

Associate Administrator
Space Operation

Date 3/18/88

APPENDIX E

ACRONYYMS AND ABBREVIATIONS

AA	Associate Administrator
AAA	Assistant Associate Administrator
ACTS	Advanced Communications Technology Satellite
AMRIR	Advanced Medium Resolution Imaging Radiometer
AMSU	Advanced Microwave Sounding Unit
APM	Attached Pressurized Module
ARC	Ames Research Center
AXAF	Advanced X-ray Astrophysics Facility
BBS	Biological, Behavioral, and Social Sciences
BBXRT	Broad-Band X-ray Telescope
CCB	Configuration Control Board
CCD	Charge-Coupled Device
CELSS	Closed Ecological Life Support System
CISE	Computer and Information Sciences and Engineering
COP	Co-Orbiting Platform
COUP	Consolidated Operations and Utilization Plan
DOC	Discipline Operations Center
DOE	Department of Energy
DWG	Discipline Working Group
ELT	Emergency Location Transponder
ENG	Engineering
EOS	Earth Observing System
EPIRB	Emergency Position Indicating Radio Beacon
EPOP	ESA Polar Orbiting Platform
ERB	Earth Radiation Budget
ERBI	Earth Radiation Budget Instrument
EROS	Earth Resources Observing System
ESA	European Space Agency
EVA	Extra-Vehicular Activity
FIP	Flight Increment Plan
GEO	Geosciences
GOMR	Global Ozone Monitoring Radiometer
GSE	Government-Supplied Equipment
GSFC	Goddard Space Flight Center
HST	Hubble Space Telescope
ICD	Interface Control Document
ICM	Increment Change Manager

IPC	Imaging Proportional Counter
ITS	Institute for Telecommunication Sciences
IWG	Investigators Working Group
JEM	Japanese Experiment Module
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
LeRC	Lewis Research Center
MBPS	Mega Bits Per Second
MCB	Multilateral Coordination Board
MOU	Memorandum of Understanding
MPS	Mathematical and Physical Sciences
MSFC	Marshall Space Flight Center
MSS	Mobile Servicing System
NASA	National Aeronautics and Space Administration
NBS	National Bureau of Standards
NCAR	National Center for Atmospheric Research
NCI	National Cancer Institute
NEI	National Eye Institute
NESDIS	National Environmental Satellite, Data, and Information Service
NHLBI	National Heart, Lung, and Blood Institute
NIA	National Institute of Aging
NIAMS	National Institute of Arthritis and Musculoskeletal and Skin Diseases
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
NIDR	National Institute of Dental Research
NIH	National Institutes of Health
NINCDS	National Institute of Neurological and Communicative Disorders and Stroke
NOAA	National Oceanic and Atmospheric Administration
NPOP	NASA Polar Orbiting Platform
NSF	National Science Foundation
NTIA	National Telecommunications and Information Administration
OER	Office of Energy Research
OMV	Orbital Maneuvering Vehicle
OSO	Office of Space Operations
OSS	Office of Space Station
OSSA	Office of Space Science and Applications
PDRD	Program Definition and Requirements Document
PI	Principal Investigator
P/L	Payload
POCB	Program Operations Control Board

POIC	Payload Operations Integration Center
POP	Polar Orbiting Platform
R&D	Research and Development
SARSAT	Search and Rescue Satellite
SCATT	Scatterometer
SEM	Space Environment Monitor
SIRTF	Space Infrared Telescope Facility
SMAME	Simultaneous Multiwavelength Astrophysical Monitoring Experiment
SOP	System Operations Panel
S&R	Search and Rescue
SSCC	Space Station Control Center
SSIS	Space Station Information System
SSOTF	Space Station Operations Task Force
SSP	Space Station Program
SSPO	Space Station Program Office
SSSAAS	Space Station Science and Applications Advisory Subcommittee
SSSAUB	Space Station Science and Applications User Board
SSSAUP	Space Station Science and Applications Utilization Plan
SSSOMC	Space Station Science Operations Management Concepts
SSSUMC	Space Station Science Users' Management Committee
SSUB	Space Station User Board
S&T	Science and Technology
SUM	Science Utilization Management
TDRSS	Tracking and Data Relay Satellite System
TIP	Technical Integration Panel
TOP	Tactical Operations Plan
UOP	User Operations Panel
U.S.	United States
USDA	United States Department of Agriculture
USGS	United States Geological Survey